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VOL. CXXXVII.—No. 3551] LONDON: FRIDAY EVENING, JANUARY 18, 1924 [PRICE {WITH INDEX AND OTHER SUPPLEMENT} 1s. 6D. BY INLAND POST 1s. 9d.

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that COMPAGNIE DES FORGES ET ACIERES DE LA MARINE ET D'HOMECOURT, a French Company, of 12, Rue de la Rochefoucauld, Paris, France, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 193,390 granted to them for "Improvements in Endless-track Vehicles."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents), issued on the 9th January, 1924.

Any person, or persons, may give notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. TEMPLE FRANKS,
Comptroller-General.
4650

Finsbury Technical College.

A CHIEF ASSISTANT of Graduate rank and with Works Experience is REQUIRED in the Electrical Engineering Department to take up duty at the end of February. Salary will be in accordance with the scale adopted by the London County Council.—Applications to be addressed to Dr. W. H. ECCLES, at the College, Leonard-street, E.C., and received not later than the 31st January, 1924. 4562

Administrative County of LONDON.
TWIN-SCREW STEAMSHIP.

The London County Council invites TENDERS for the CONSTRUCTION and DELIVERY of a TWIN-SCREW STEAMSHIP, about 260ft. long by 43ft. beam, with machinery, &c., for the Conveyance of 1500 tons of Sewage Sludge from the Outfall Works at Crossness and Barking Creek to the North Sea.

Persons desiring to submit Tenders may obtain, on and after Monday, 21st January, 1924, the drawings, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £5. This amount will be returnable only if a bona fide Tender is submitted and not subsequently withdrawn. Full particulars may be obtained on personal application, and the drawings, specification and other contract documents may be inspected at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 11th February, 1924, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.
4674

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

9 SPANS, DECK SPAN GIRDER BRIDGES, 60ft. Spans.
6 SPANS, DECK SPAN GIRDER BRIDGES, 40ft. Spans.

Specification and form of Tender can be obtained at the Company's offices, 132, Gresham House, Old Broad-street, E.C. 2, on or after 14th January, 1924.

A fee of 20s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Monday, 28th January, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

By order of the Board,
R. C. VOLKERS,
Secretary.
4642

City of Carlisle.
ELECTRICITY DEPARTMENT.
NEW ELECTRICITY GENERATING STATION.

TENDERS are invited for the SUPPLY, DELIVERY and ERECTION of the following PLANT for the above :—

SPECIFICATION 24/1.—Four Water-tube Boilers with Stokers, Economisers, Bunkers, Fans, Chimneys, Coal and Ash Handling Plant.
SPECIFICATION 24/2.—Electrically-operated Overhead Turbine Room Crane.
SPECIFICATION 24/3.—A 5000-kilowatt Turbo-Alternator and Condensing Plant.
SPECIFICATION 24/4.—Generating Station Switchgear.

Specifications and Tender forms may be obtained from the undersigned on payment of a deposit of 10s. 6d. in respect of each specification required.

The sum deposited will be returnable on receipt of a bona fide Tender.

Sealed and endorsed Tenders are to be delivered to the Electricity Offices, Victoria Viaduct, Carlisle, not later than Twelve Noon on Friday, 15th February.

CHAS. W. SALT, M.I.E.E.,
City Electrical Engineer.
15th January, 1924. 4661

City of Chichester.
TENDERS FOR SUCTION GAS PLANT.

The Town Council invite TENDERS for the SUPPLY and ERECTION of a SUCTION GAS PLANT suitable for a 140 B.H.P. Two-cylinder Gas Engine at the Water Pumping Station.

Further details can be obtained from the City Engineer, Mr. Frank J. Lobley, A.M.Inst. C.E., "Greyfriars," North-street, Chichester, during the usual office hours.

Sealed Tenders, endorsed "Suction Plant," must reach me not later than the first postal delivery on Monday, 28th January, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

J. W. LOADER COOPER,
Town Clerk.
14th January, 1924. 4658

City of Chichester.
TENDERS FOR MACHINERY.

The Town Council invite TENDERS for the SUPPLY of the MACHINERY specified below.

One Dynamo, 120 volts, 150 amps. (approximately) at 500 to 800 r.p.m. and appurtenant gear.
One Sludge Pump, 9in. diameter by 12in. stroke or equivalent, driven by Electric Motor (120 volts, D.C.) by suitable gearing.
Two 7 B.H.P. Air Compressors, and Electric Motors to drive same.

Any further details can be obtained from the City Engineer, Mr. Frank J. Lobley, A.M. Inst. C.E., "Greyfriars," North-street, Chichester, during the usual office hours.

Sealed Tenders, endorsed "Outfall Machinery," must reach me not later than the first postal delivery on Monday, 28th January, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

J. W. LOADER COOPER,
Town Clerk.
14th January, 1924. 4659

The Engineer

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Some Large Hydraulic Turbines (With a Two-Page Supplement).

The Emmet Mercury Vapour Plant.

Pneumatic Grain Elevators—No. II.

Harbours and Waterways in 1923.

Scottish Road Conference.

New Switchgear at the Neasden Power Station.

The Winter Train Services in France.

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PUBLIC NOTICES

County of London.

The London County Council invites TENDERS for the SUPPLY, DELIVERY and ERECTION of HIGH and LOW-TENSION SWITCHGEAR, comprising High-tension Switchgear with Control Panels and Direct-current Switch Panels for 2600 K.W. Rotary Converters.

The specification, form of Tender, and general conditions may be obtained from the General Manager, London County Council Tramways, Victoria Embankment, W.C. 2, upon payment of a deposit of £2. This amount will be returnable only if a bona fide Tender is submitted and not withdrawn. Particulars of the work may be obtained at the Tramway Offices, Victoria Embankment, before payment of the deposit.

Tenders must be delivered to the Clerk of the Council at the County Hall, Westminster Bridge, S.E.1, not later than 4 p.m. on Monday, 11th February, 1924. No Tender received after that time will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
Clerk of the London County Council.
4643

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. TENDERS for the SUPPLY of—

(1) STEEL TYRES for LOCOMOTIVES.
(2) BOGIE LUGGAGE VANS.

For No. 1 on Wednesday, the 30th January instant, and for No. 2 on Wednesday, the 6th February proximo.

Copies of the specifications can be obtained at the Company's Offices on payment of £1 1s. each. This fee is not returnable.

G. E. LILLIE,
Secretary.
73-76, King William-street, London, E.C. 4,
16th January, 1924. 4670

Egyptian State Railways.

TENDERS are REQUIRED for the CONSTRUCTION of STEEL ROOFS and SHELTER at Alexandria New Station.

Copies of the specification and drawings may be obtained from the Inspecting Engineer, Egyptian and Sudan Governments, Queen Anne's Chambers, Broad way, Westminster, S.W., on payment of 56 3s.

Tenders are to be submitted to the AUTHORITIES IN CAIRO not later than the 1st May, 1924. 4676

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for—

1. SHEFFIELD TOOLS, &c. ..... 5s.
2. RAILWAY TICKETS ..... 7s. 6d.

Tenders are due by 11 a.m. on 29th January, 1924. Tender forms obtainable at above address Fees not returnable. 4678

Keighley Corporation.
WATERWORKS DEPARTMENT.
9in. CAST IRON PIPES.

The Corporation of Keighley invite TENDERS for the MANUFACTURE and DELIVERY of 9in. CAST IRON SOCKET and SPIGOT PIPES to British Standard Specification Class C.

Copies of specification and schedule of quantities can be obtained from the Engineer, Mr. M. Ratcliffe Barnett, M. Inst. C.E., Town Hall, Keighley, on and after Saturday, January 19th, 1924.

Sealed Tenders, endorsed "Keighley Waterworks, 9in. Pipes," addressed to the Chairman of the Waterworks Committee, must be delivered to the undersigned not later than Saturday, the 2nd February, 1924.

The Corporation do not bind themselves to accept the lowest or any Tender.

SMITH TERRY,
Town Clerk.

Town Hall, Keighley,
January 14th, 1924. 4657

PUBLIC NOTICES

The Cornwall County Council invites TENDERS for the CONSTRUCTION of a large STEAM CHAIN FLOATING BRIDGE for use on its Ferry service between Devonport and Torpoint.

Copies of the drawings and specification and a form of Tender may be obtained from the undersigned on payment of Two Guineas, which will be returned on receipt of a bona fide Tender, and, if the Tender is not accepted, on the return of all papers and documents.

Sealed Tenders, endorsed "Floating Bridge," should be received by the undersigned not later than 10 a.m. on Tuesday, the 12th February, 1924.

The Council does not bind itself to accept the lowest or any Tender.

W. L. PLATTS,
Clerk of the County Council.
County Hall, Truro,
15th January, 1924. 4664

Windsor Union.
RECONSTRUCTION OF ENGINEERING SERVICES AT POOR LAW INSTITUTION, OLD WINDSOR.

The Guardians of the Windsor Union invite TENDERS for the RECONSTRUCTION of the ENGINEERING SERVICES at the Poor Law Institution, Old Windsor, Berks.

Contractors must Tender for the whole of the work (and not for separate parts thereof), which will comprise the Supply and Erection of Steam Boiler and Steam Services to Kitchen and Laundry, Repair and Reconstruction of Steam Apparatus in Kitchen and Laundry, Supply and Erection of Central Hot Water Heating and Hot Water Supply Installations and Reconstruction of Existing Hot Water Apparatus, Wiring for Electric Lighting, Supply and Erection of Electric Motor in Laundry and Wiring therefor, &c.

The specification and drawings and form of Tender may be seen at the Poor Law Institution, Old Windsor, between the hours of 10 a.m. and 4 p.m. on week-days from Saturday, the 19th January, 1924, to Saturday, the 2nd February, 1924.

Copies of the drawings and specification can be obtained from Mr. Walter W. Nobbs, M.I. Mech. E. (the Consulting Engineer in charge of the works), of 50, Fairhazel-gardens, N.W.6, on payment of a sum of £5 5s., which will be refunded on receipt of a bona fide Tender with specification and drawings.

Sealed Tenders must be sent to me at 16, Sheet-street, Windsor, marked "Engineering Works," by Monday, the 11th February, 1924.

The Guardians do not pledge themselves to accept the lowest or any Tender.

J. E. GALE,
Clerk to the Guardians.
8th January, 1924. 4633

Windsor Union.
CONSTRUCTION OF BOILER HOUSE AND SETTING OF CORNISH BOILER, ERECTION OF CHIMNEY SHAFT, &c.

The Guardians of the Windsor Union invite TENDERS for the CONSTRUCTION of BOILER-HOUSE, FOUNDATION and SETTING of CORNISH BOILER, FIRE-BRICK LINED CHIMNEY, and sundry BUILDERS' WORK in attendance on Engineers, at Poor Law Institution, Old Windsor, Berks.

Plans and specification can be seen at the Poor Law Institution, Old Windsor, Berks, between the hours of 10 a.m. and 4 p.m. on week-days from Saturday, the 19th January, 1924, to Saturday, the 2nd February, 1924.

Copies of drawings, specification and form of Tender can be obtained from Mr. W. W. Nobbs, M.I.Mech.E. (the Consulting Engineer in charge of the works), of 50, Fairhazel-gardens, N.W.6, on payment of a sum of £2 2s., which will be refunded on receipt of a bona fide Tender with specification and drawings.

Sealed Tenders must be sent to me at 16, Sheet-street, Windsor, marked "Builders' Work," by the 11th February, 1924.

The Guardians do not pledge themselves to accept the lowest or any Tender.

J. E. GALE,
Clerk to the Guardians.
8th January, 1924 4634

PUBLIC NOTICES

Ewart and Collis, Limited
(In Voluntary Liquidation.)

The ASSETS of the above COMPANY, other than the shareholding in Ewart and Son, Limited, are FOR SALE, and OFFERS for them are INVITED.

The Freehold Land (about 7¼ acres), having a frontage of approximately 650ft. on the Hanworth-road, Sunbury Common Middlesex Buildings situated thereon, Plant, Machinery, Motor Lorries, Stock and Goodwill are included in the Assets now offered, and an approximate schedule and an order to view can be obtained on application to the Liquidator—

Sir WILLIAM HENRY PEAT, K.B.E.,
11, Ironmonger-lane, E.C.

to whom all Offers should be submitted on or before 18th February, 1924. 4622

Southborough Urban District COUNCIL.
WATERWORKS.

The Southborough Urban District Council invite TENDERS from Contractors experienced in Well and Heading Work, for DRIVING 100 Yards of HEADINGS, more or less, at their existing Waterworks at Upper Hayesden, near Tonbridge, whilst the supply to the district is being maintained.

A plan of the work may be seen at the waterworks or at the office of the Engineers, Messrs. G. and F. W. Hodson, M.Inst.C.E., Loughborough and London, and copy of the particulars may be obtained from them on deposit of cheque for £5 5s., which will be refunded to bona fide tenderers on return of the documents.

Sealed Tenders, endorsed "Tender for Waterworks Headings, &c.," are to be addressed to the undersigned, and delivered at the Council Offices, Southborough, on or before Monday, 4th February, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

Dated 15th day of January, 1924.

W. N. WOOD,
Clerk to the Council.
Council Offices,
Southborough, Kent. 4681

The Ministry of Public Works, EGYPT, is calling for TENDERS for the SUPPLY and ERECTION of a PUMPING PLANT at Bonelli.

The contract will include the supply, delivery and erection of the whole of the Machinery and Accessories, including 4 Internal Combustion Engines each directly coupled to Centrifugal or Turbine Pump.

Forms of Tender and specification, price 10s., can be obtained at the office of the INSPECTING ENGINEER, Egyptian and Sudan Governments, Queen Anne's Chambers, Westminster, S.W. 1.

Tenders must be sent direct to Cairo, to reach there not later than Noon on the 31st March, 1924. 4637

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—

POINTS AND CROSSINGS, &c.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W.1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Points and Crossings, &c.," must be left with the undersigned not later than Twelve Noon on Friday, the 8th February, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of the specification.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

W. B. REYNOLDS,
For Managing Director.
11th January, 1924.
91, Petty France, S.W. 1. 4628

Wembley Urban District COUNCIL.
TO RAILWAY AND PUBLIC WORKS CONTRACTORS.

The above Council invite TENDERS for the WIDENING of the BRIDGE carrying Wembley Hill-road over the L. and N.E. Railway (Great Central Section) main line. The nature of the work will be the addition of a reinforced concrete structure, 16ft. wide, on the east side of the existing bridge.

Specification, schedule of quantities, and form of Tender may be obtained from the undersigned on payment of a deposit of Two Guineas, which will be returned on receipt of a bona fide Tender.

Plans of the proposed work may be inspected during office hours at the office of the Engineer to the Great Central Section of the L. and N.E. Railway Company, King's Cross Station, on production of the form of Tender.

Sealed Tenders, in the envelope supplied, to be delivered to the undersigned not later than Noon, Wednesday, January 30th, 1924.

The Council do not bind themselves to accept the lowest or any Tender.

WALTER H. LEWIS,
Acting Engineer and Surveyor.
Council Offices,
Wembley, Middlesex.
7th January, 1924. 4582

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SITUATIONS OPEN

WANTED, a Thoroughly Capable MAN to Take Charge of Light Tank and Metal Plate Work Department of old-established firm in Lancashire. Applicants must have previous experience in this class of work, ability to do ordinary Draughting, Compile Estimates, and Superintend Production. A knowledge of Welding (Electric and Acetylene) would be advantageous. State age, experience, when free and salary expected.—Address, in first instance, 4635, The Engineer Office. 4635 A

WANTED, Energetic Experienced TRAVELLER; must be practical engineer, with established connection outside London area, to Represent Firm of Manufacturing Engineers in Steam Engines, Woodworking Machinery, Contractors' Plant, and General Engineering Work. State fullest particulars, age, district, salary.—Address, 4609, The Engineer Office. 4609 A

WANTED, ENGINEER to Take Charge of Stand at Wembley Exhibition for important North Country Heavy Engineering Firm. Applicants should have commercial experience and good technical knowledge of Steam and Oil Prime Movers.—Address, stating age, experience and salary required, 4580, The Engineer Office. 4580 A

WANTED, Experienced ESTIMATOR, Used to Boilers, all types, Tanks, Steel Work.—Address, 4636, The Engineer Office, stating age and salary required. 4636 A

WANTED, LONDON REPRESENTATIVE for first-class Gas and Oil Engine Makers to sell on commission basis; must have previous experience.—Address, 4554, The Engineer Office. 4554 A

ASSISTANT ENGINEER REQUIRED, with Thorough Mechanical and Electrical Engineering and preferably Chemical Knowledge; must be accustomed to Building and Installation of Factories. Maintenance Work, &c. State salary required.—Address, 4653, The Engineer Office. 4653 A

ASSISTANT MANAGER WANTED for Marine Engineering Works in China. Applicants must possess thorough technical and also practical knowledge of Modern Marine Engineering. Age 35 to 40. Salary commencing £750.—Address, detailing experience and qualifications for the post, P8559, The Engineer Office. P8559 A

ASSISTANT WORKS MANAGER, with Good Organising Ability, mechanical knowledge and previous managerial experience, REQUIRED by large firm of Rolling Stock Engineers; all-round knowledge of Steel and Wood Construction necessary. Good salary to right man.—Address, 4632, The Engineer Office. 4632 A

CEMENT.—WORKS ENGINEER WANTED for India. A fully competent man with thorough knowledge of Cement Making.—Write, "E. C. T.," c.o. Street's, 30, Cornhill, E.C. 3. 4671 A

CIVIL ENGINEER.—ASSISTANT REQUIRED for Railway Engineer's Office. Applicants should be Associate Members of the Institution of Civil Engineers, or hold equivalent professional qualifications. Experience in all branches of Railway Engineering, including Structural Design, and ability to turn out neat and reliable work expeditiously, is essential. Applicants should give full particulars of qualifications and experience, age and salary required. —No. 462, Keith and Co., Advertising Agents, Edinburgh. 4623 A

ENGINEER WANTED to Take Control of the Shops under the Managing Director. Applications only desired from those having the highest qualifications and experience in the maintenance and output of a Machine Tool Shop. State age, experience, and salary required.—Address, 4599, The Engineer Office. 4599 A

JAPAN AND BRITISH INDIA.—APPLICATIONS are INVITED for POSITION of REPRESENTATIVE in Japan and British India respectively, for large High-grade Steel Works. Applicants must have good technical knowledge of High-speed and Tool Steels, and good business experience; must also be personally acquainted with local conditions.—Write, giving full particulars of experience, &c., 4620, The Engineer Office. 4620 A

MELTING SHOP MANAGER WANTED. Thoroughly experienced in both Acid and Basic Processes of Steel-making with cold and hot metal in a modern plant.—Apply, stating age, experience, qualifications and salary expected, to the SECRETARY, the Consett Iron Company, Ltd., Consett, Co. Durham. 4630 A

WORKS MANAGER.—A South Coast Firm of Heating and Lighting Engineers REQUIRE a thoroughly competent live WORKS MANAGER. Applicants should be fully qualified and especially conversant with country-house Heating and Lighting. —Address, stating experience, age and salary required, 4684, The Engineer Office. 4684 A

WANTED, an Experienced CHECKER for Drawing-office engaged on work of very varied character, including Steel Structures, Buildings, all kinds of Power Plant and Electrical Apparatus. Age about 30. Applicants to state particulars of experience and salary expected.—Address, 4621, The Engineer Office. 4621 A

DESIGNER FOR REINFORCED CONCRETE.—WANTED, fully qualified MAN, with wide experience in design and details of R.C. Structures.—Applications to be made in writing, giving full information as to experience, qualifications, age and salary required, addressed to the CHIEF ENGINEER, The Gas Light and Coke Company, Horseferry-road, London, S.W. 1. 4607 A

DRAUGHTSMAN (CHIEF) REQUIRED for Structural Works; efficient Organiser, capable of Designing on most modern and competitive lines; only applicants having these qualifications will be considered. State experience, salary required, with copies of testimonials.—Address, "STRUCTURAL," Wm. Porteous and Co., Glasgow. 4673 A

DRAUGHTSMAN, Experienced, WANTED, for Steam or Petrol Wagon Work. State experience, age and salary.—Address, 4665, The Engineer Office. 4665 A

DRAUGHTSMAN REQD., London, with Thorough exp. Elevator and Conveyor Designs. Aged 28/40. £364 p.a.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-st., E.C. 2. No preliminary fee. 4669 A

DRAUGHTSMAN REQUIRED. Must have had Experience with Constructional Engineering Firm.—Address, 4651, The Engineer Office. 4651 A

DRAUGHTSMEN (SENIORS). First-class Men only, for Switchgear, REQUIRED by London firm. Good money for right men.—Address, 4640, The Engineer Office. 4640 A

DRAUGHTSMEN.—THE BRITISH THOMSON-HOUSTON CO., Neasden-lane, Willesden, N.W.10, INVITE APPLICATIONS from first-class SWITCHGEAR DRAUGHTSMEN.—Write, stating age, salary and experience, to CHIEF DRAUGHTSMAN. 4641 A

DRAUGHTSMAN WANTED, Accustomed to Design of Steel-framed Buildings and Structures for home and abroad. State experience and salary required.—Address, "DESIGN," Wm. Porteous and Co., Advertising Agents, Glasgow. 4672 A

DRAUGHTSMAN WANTED, Accustomed to Design of Steel-framed Buildings and Structures for home and abroad. State experience and salary required.—Address, "DESIGN," Wm. Porteous and Co., Advertising Agents, Glasgow. P8540 A

DRAUGHTSMAN (CHIEF) REQUIRED for Structural Works; efficient organiser, capable of Designing on most modern and competitive lines. Only applicants having these qualifications will be considered. State experience, salary required, with copies of testimonials.—Address, "CHIEF," Wm. Porteous and Co., Advertising Agents, Glasgow. P8541 A

DRAUGHTSMEN WANTED by London Firm, with first-class experience in the Design and Lay-out of up-to-date Switchgear. Good salary for really capable men.—Write, stating age, experience and salary required, 4639, The Engineer Office. 4639 A

Workmen's Compensation Act, 1923.

"FIRST AID"

Home Office Order dated January, 1924.

All factories must in future be provided with First Aid Box or Cupboard.

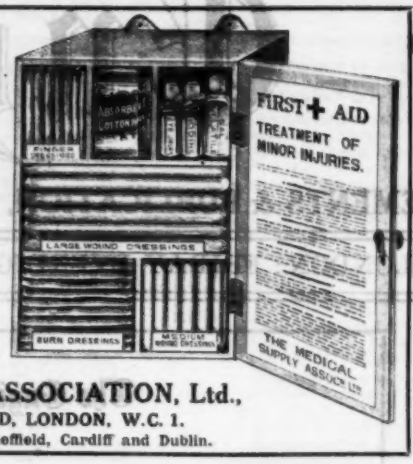
We supply First Aid Boxes for all Trades affected by the above Act.

A.—For factories employing 50 persons or less, Case No. 24, each 30/-.

B.—For factories employing more than 50 persons, Case No. 3, each 50/-.

Write for complete First Aid Catalogue.

Telephone: Museum 7210 (3 lines). Telegrams: "Grevillite, Kincross, London."



The MEDICAL SUPPLY ASSOCIATION, Ltd.,

167-185, GRAY'S INN ROAD, LONDON, W.C. 1.

Branches: Edinburgh, Glasgow, Sheffield, Cardiff and Dublin.

SITUATIONS OPEN (continued)

ELECTRICAL ENGINEER - DRAUGHTSMEN WANTED by Firm in N.W. London for the Preparation of Connection Diagrams for Power Station Switchgear. First-class men with good technical training only need apply.—Write, stating age, experience and salary required, 4638, The Engineer Office. 4638 A

FIRST-CLASS STRUCTURAL DRAUGHTSMEN REQUIRED; none but experienced men need apply. State full particulars, age, salary required.—THE CLEVELAND BRIDGE and ENGINEERING CO., Ltd., Darlington. 4453 A

SENIOR DRAUGHTSMAN REQUIRED for Chief Mechanical Engineer's Office on a Chilian Railway. Salary £450/500 per annum, according to abilities. Three years' contract; free passage out and home; free quarters provided.—Write full particulars to "K. M.," c.o. Charles Barker and Sons, Limited, 31, Budge-row, Cannon-street, London, E.C.4. 4646 A

THOROUGHLY EXPERIENCED DRAUGHTSMAN WANTED; Refrigeration Practice essential. Letter only; fullest particulars.—WEST-BEYNON, 82, Belvedere-road, S.E. 1. 4633 A

FOREMAN REQUIRED to Take Charge of Millwrights and Machine Tool Repairs in large general engineering factory, London district; must be fully experienced in this class of work and used to the control of men.—Address, stating age, full details of experience, with names of firms and dates, also salary required, 4662, The Engineer Office. 4662 A

SITUATIONS WANTED

A. M.I.C.E., Age 33, 5 Years' Highest-class Machine shop and drawing-office experience, 5 years' war service, at present engaged as assistant engineer on design, lay-out, erection and maintenance of manufacturing plant, SEEKS NEW POST with prospects.—L., 277, Northfield-avenue, S. Ealing, W. 5. P8549 B

A. M.I.C.E. (33), Railway Locomotive Works and D.O., charge of locomotive steam sheds, automobile, hydraulic and general engineering, maintenance of plant, inspections and estimates, used to control of large staffs, wide technical knowledge, DESIRES POST, works or office.—Address, P8487, The Engineer Office. P8487 B

A. M.I. MECH. E. (37), Public School, University, ex-officer, 11 years with consulting engineers and naval architects, DESIRES POST as LONDON REPRESENTATIVE Engineering Firm. Connections among shipbuilders, ship repairers, oil companies, consulting engineers, marine surveyors, &c. No agents.—Address, P8502, The Engineer Office. P8502 B

ADVERTISING ADVISORY SERVICE for Small Engineering Concerns GIVEN by Free-lance Technical Advertisement Writer at moderate charges; inquiries solicited.—Address, P8555, The Engineer Office. P8555 B

APPLICANT, with Sound-Up-to-date and Economical systems of production and work organisation, SEEKS APPOINTMENT as Assistant Works Manager, Works Superintendent, or Production Engineer. Expert in jig and tool design for mass production; 22 years' first-class drawing-office and workshop experience. London district preferred.—Address, P8528, The Engineer Office. P8528 B

ASSISTANT BUYER, with One of the Largest industrial concerns in the country, DESIRES CHANGE; first-class experience and connections; salary required, £300 upwards, according to responsibility.—Address, P8538, The Engineer Office. P8538 B

CAPABLE ENGINEER MANAGER DESIRES APPOINTMENT; wide technical, practical and commercial knowledge; experienced in modern production methods, latest machine shop and foundry practice, general and high-class repetition work; 22 years' departmental, works and general management experience; efficient organiser and controller of large staff; first-class references.—Address, P8554, The Engineer Office. P8554 B

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Standardised Viscometry.

WHEN the Engineering Standards Committee was formed in 1901, the object in view was the very limited one of establishing standard dimensions for structural rolled sections. Since that date the Committee—or the Association, as it became in 1918—has widened the ground of its interests to a very remarkable degree. To-day, it has in circulation about 175 different specifications, or reports, covering many aspects of mechanical, civil, electrical, marine and automobile engineering, besides chemistry and other applied sciences. It has issued, among other matters, a report on locomotives for Indian railways, a glossary of aeronautical terms, a specification for an electric cooking range, and a similar document dealing with table glass and crockery for use on ships. Its latest publication, received since our last issue, is one giving particulars of a standard method for the determination of viscosity in absolute units. This specification is the work of a panel of the Aircraft Sub-committee on Chemicals, and has received the approval of the Institution of Petroleum Technologists, the Society of Chemical Industry, the Oil and Colour Chemists' Association, and the Association of British Chemical Manufacturers. It gives standard dimensions for U-tube, co-axial bulb and falling sphere viscometers and specifies the standard liquids recommended for their calibration. The manner in which the instruments are to be used and calibrated is detailed. For use in the determination of the viscosity of opaque liquids, the Lidstone viscometer and adaptations of the U-tube and falling sphere viscometers are described. The falling sphere viscometer, it may be remarked, is not identical with the cup-and-ball instrument introduced by Mr. Michell—see our issue of November 17th, 1922—but an instrument in which is observed the time of fall of a steel ball through a measured height in a column of liquid. We note with interest that the term "poise" is adopted as the name of the C.G.S. unit of viscosity—after, it is obvious, Poiseuille, whose experiments on the efflux of liquids from capillary tubes in 1843 laid the foundation for modern viscometry. Hitherto, this subject has been much incommoded by the number of different arbitrary units in use.

Scottish Road Conference.

ON Tuesday and Wednesday a Scottish Road Conference was held in the City Chambers, Edinburgh. It was convened under the auspices of a number of municipal authorities and other bodies, and it was noteworthy in several respects. First of all, the writers of the papers were only allowed 10 min. in which to introduce their subjects. Then, again, those taking part in the discussions were only allowed 5 min. each in which to put forward their views, and each had to announce his name and the Authority he represented before beginning to speak. The papers had all been circulated beforehand, so that the delegates only had themselves to blame if they had not made themselves conversant with the subjects to be discussed. It seems to us that other similar conferences might usefully adopt some such regulations as the foregoing. If a man, well up in his subject, has really got a point to make, 5 min. generally gives him ample time in which to make it. There are, of course, occasions on which a meeting may patently desire to hear more from a particular speaker. In that case the chairman might, at his discretion, permit him to speak longer; but discussions would gain much more than they would lose if speakers were, as a general rule, rigidly circumscribed as to time. We give a brief summary of the subjects of the papers in another column.

Water Power in Canada.

SEVERAL notable events in connection with the development of water power in Canada took place last week. The first was the putting into service of another unit, capable of developing 55,000 horse-power, at Niagara Falls. This machine is among the largest so far constructed, but will shortly be eclipsed by one of 70,000 horse-power, being built in the United States. The new Canadian turbine brings the capacity of the hydro-power plant up to a total of 330,000 horse-power, which will be increased to 550,000 horse-power when two more units, in course of construction, are put into commission. Another item of news was that announcing the ordering in England from Vickers, Limited, of a 25,000 horse-power turbine for the Calumet plant on the Ottawa River. By comparison with the turbines just mentioned, the output of this machine is not large, but it will be noteworthy through being by far the largest single-runner Francis turbine built in England. Finally, an important delegation pressed on the Government the necessity for proceeding with a scheme for developing the power of the St. Lawrence River. This scheme involves the construction of a dam across the river near Morrisburg, and would ultimately result in the generation of 6,000,000 horse-power. It is estimated that the cost of the works would be £16,000,000, which works out at the remarkably low price of just under £2.7 per horse-power. The proposal is that the Province of Ontario should find £10,000,000 towards the cost, while the Governments of Canada and the United States should each provide £3,000,000.

Transient Track Circuits on Railways.

MENTION has frequently been made in these pages of track circuit, and there may be some readers who do not know what it is. It is an electrical circuit through the rails which is short circuited should any vehicle be within the section of track circuit. At the end of the section is a battery, one terminal of which is connected to one rail. The rails are bonded together by a light wire, and at the other end of the section is a relay controlling a signal or a lock on a lever, and there is a return through the other rail. As long as the section is unoccupied the relay is energised, but as soon as a train enters the section the circuit is made through the wheels and the relay is de-energised. At the Institution of Railway Signal Engineers a paper by Mr. E. A. Hudd has just been read, which describes a transient track circuit wherein current, instead of flowing continuously, is only sent through the section when the signal for entering it has to be lowered. The arrangement is not as simple as the ordinary track circuit, and a higher class of linesman may be required to attend to it, but it is claimed that the economy in battery power would meet any increased expense. An installation of this description has been in operation on the main line to York at Retford for over twelve months, and the Metropolitan Railway Company is about to put down two installations, each about 2¼ miles in length, which will allow a signal-box to be closed.

Electrical Research.

AT a luncheon held at the Connaught Rooms last Friday, January 11th, some interesting facts were brought to light concerning the activities and financial outlook of the British Electrical and Allied Industries Research Association. Mr. C. H. Wordingham, the retiring president, explained that a good deal of attention had been paid to the study of insulating materials, with a view to improvement in manufacture and quality, and with the object of arriving at definite conditions to which those materials should conform. Important work had been done in connection with control gear and switches, and the Association had issued reports, which, if acted upon, would save the electrical industry large sums of money. Much time had been devoted to the investigation of industrial products. The activities of the Association, Mr. Wordingham went on to explain, were only limited by funds. The Government grant covered a period of but five years, but he had great hopes of its being extended, for he felt sure that the Government would recognise that a five years' grant was insufficient to put the Association firmly on its feet. The main funds came from the "Beama." The Institution of Electrical Engineers also contributed towards the upkeep of the Association, and they expected that assistance would be obtained from the Electricity Commissioners, who were greatly interested in the Association's work. Dr. Glazebrook also spoke on the great importance of the Association, and remarked that no industry was in greater need of research than the electrical industry.

A New Wireless Service.

A WIRELESS telegraph service between England and Austria was officially inaugurated last Saturday, January 12th, when several telegrams of congratulation passed between the two countries. The service is operated by Marconi's Wireless Telegraph Company, in conjunction with the Austrian Marconi Company. Transmissions from Radio House, London, pass through the Marconi station at Ongar, Essex, to Laaerberg, where the messages are automatically relayed to the central office at Vienna. Transmissions from Vienna are dealt with by the Deutsch-Altenburg station, and the messages for Great Britain are received at the Brentwood station and are automatically relayed to Radio House. The transmission of a message between London and Vienna takes from 10 to 15 minutes, and the charges are at present the same as those for land-line telegraphy. A wireless service between Vienna and Berlin has also been established, and eventually the Austrian station will place Vienna in communication with all the principal European cities.

A Clyde Hydro-Electric Scheme.

THE waters of the river Clyde in the neighbourhood of the celebrated falls, Stone Byres, Cora Lynn and Bonnington, are, it is proposed, to be tapped for the purpose of generating a supply of electricity. An undertaking designated the Lanarkshire Hydro-Electric Power Company has applied to the Secretary for Scotland for a Provisional Order to incorporate itself as a statutory company with powers to construct and operate electric generating stations in the neighbourhood of the town of Lanark. The particulars of the scheme at our disposal are at present a little vague, but such as they are, they appear to indicate that while the proposal involves the construction of two weirs across the river, it will not result in the natural beauty of the falls being affected except possibly by a diminution of the flow over them. The company proposes to start with a capital of £250,000, to be increased later to £400,000, and to supply electricity from its works to certain towns in the neighbourhood, to the London, Midland and Scottish Railway and to the Clyde Valley Electric Power Company. The promoters are Lord Meston, Sir Hugh Reid, Mr. P. J. Pybus, Mr. W. L. Hichens and Mr. T. Sampson. The first directors would be Sir George May, Sir Hugh Reid and Mr. Pybus. It may be recalled that these gentlemen are members of the board of directors of the Power and Traction Finance Company, an undertaking registered in April, 1922, and representing a combination of Cammell Laird and Co., Limited, Sir William Arrol and Co., Limited, the English Electric Company, Limited, the North British Locomotive Company, Limited, John Brown and Co., Limited, and the Prudential Assurance Company, Limited. This company was formed with the object of undertaking and, if necessary, financing large engineering contracts for railways, rolling stock, power stations, docks and harbours, and in general all aspects of power production and transport work.

The Threatened Strike of Locomotive Enginemen.

ON Friday last the general managers saw representatives of the Associated Society of Locomotive Engineers and Firemen in connection with the refusal of the latter to accept the findings of the National Wages Board, and later in the day sent word that they were unable to find any grounds upon which they could properly depart from their expressed intention to carry out the findings. On Saturday, Mr. Bromley, the secretary of the men's society, announced that "there is nothing for it now but to strike." Preparations have, it is said, been made for such a step, but the National Union of Railwaymen has announced its intention to abide by the promise given to accept the findings. Meanwhile, the General Council of the Trades Union Congress—whose representative signed the decision of the Wages Board—is endeavouring to find a way out. A point that should be cleared up is the statement in *The Times* of Tuesday that it is said in well-informed quarters that a letter to secretaries of branches which accompanied ballot papers indicated that a majority for a rejection of the findings would not necessarily involve a strike.

C.P.R. Ships for Clydebank.

IT is announced that the Canadian Pacific Company has placed an order with John Brown and Co., Limited, Clydebank, for the construction of two new passenger vessels for its Vancouver coasting services. The new ships will embody the latest improvements, and accommodation will be provided for about 325 night passengers on each ship, which will have a measurement of approximately 5000 tons gross. We are given to understand that the design adopted is to be similar to that of the Princess Irene and the Princess Margaret, which ships were nearing completion at the outbreak of war. The first-named vessel was lost by explosion during the war. The second was retained by the Navy and is now a mine-layer. The Clydebank yard begins the year with good prospects. In addition to the new C.P.R. boats, which are to be ready for the 1925 season, work is proceeding on the Orient liner Oronsay, and the Cunarder Carmania, which arrived at Clydebank just before the end of last year, is to be reconditioned and fitted with oil-burning appliances. Marine oil engines are not to be neglected, and two sets of six-cylinder Brown-Sulzer engines will be constructed during the year for a large 460ft. cargo ship for Australian service.

The Submarine Disaster.

ON Thursday morning of last week the submarine L 24, while exercising with the ships of the Atlantic Fleet off Portland, was rammed by H.M.S. Resolution, and sank almost without a sign in about 31 fathoms of water. The wreck was located the following day 10 miles south-west of Portland Bill, but bad weather, combined with the great depth at which it lay, prevented diving operations being conducted until Monday evening. When a descent was eventually made, the wreck was definitely confirmed to be that of the L 24, and not, as some had anticipated, that of a German submarine sunk in the same neighbourhood during the war. The position of the vessel was found to be such that salvage operations would be impossible. The submarine at the time of the disaster carried a complement of forty-three officers and men. She belonged to a large class, some of the later members of which are still under construction. She had on the surface a displacement of 890 tons, a horse-power of 2400 and a speed of 17½ knots. Submerged, her displacement was 1070 tons, her horse-power 1600 and her speed 10½ knots. She was not equipped with a gun, but, like two sister vessels of her class, was provided with four torpedo tubes and facilities for carrying fourteen mines.

The Turbines at Raanaasfoss Power Station, Norway.*

By HALLGRIM THORESEN, Consulting Engineer, Christiania.

No. I.

RAANAASFOSS electric power station, a general view of which is given in Fig. 1, belongs to the county of Akershus, Norway. It develops power from the Raanaas fall in the Glommen River, about 27 miles north-west from Christiania. The installation lies below the junction of the Wormen and the Glommen Rivers, and thus utilises the combined flow of both. The power station forms a part of a dam, which is about 900ft. long, and is built right across the river, thus creating a reservoir about 3.2 square miles in area. The junction of the Vormen and the Glommen Rivers lies within this area. As the county of Akershus owns the falls lying between Raanaasfoss and lake Oieren, the Raanaasfoss power station can utilise the possibilities of daily regulation afforded by the reservoir without interfering with installations situated further down the river.

DETERMINATION OF SIZE OF UNITS AND CHOICE OF TYPE OF TURBINE.

The minimum flow of water passing the site when the development was planned was 7700 cubic feet per second. Since by regulating the lakes lying above it would be possible to bring the minimum winter flow up to about 11,000 cubic feet per second, and as there was every probability that such regulation would be carried out in the near future, it was decided that a minimum flow of 9500 cubic feet could be taken as the basis for determining the size of the plant. In making this decision due consideration was given to the fact that, owing to the large reservoir formed by the dam, sufficient storage was provided to deal with the daily variation in the power delivered, and the size of the machines was, therefore, based on the possibility of having an available flow of 12,000 cubic feet per second—9500 cubic feet plus about 25 per cent. In winter the head is about 43.3ft., but in flood time it may be reduced to about 31.1ft. owing to the rise in tail water level. By blasting away the Sundfoss fall below the power station, the head in winter could be increased to 46ft.

On the above basis and having regard to the desirable size of the units from a manufacturing point of view, it was decided to divide the 12,000 cubic feet per second between four units, of 3000 cubic feet each. In order, however, to obtain the same output during flood time when the head is reduced, and with a view to the possibility of delivering flood power in the summer half of the year and also in order to have some reserve, it was decided that six units should be installed, each of which could utilise 3150 cubic feet per second at a head of 40ft.

With four machines running, this plant can produce 51,000 horse-power with 12,000 cubic feet per second at a 43.3ft. head. This output can be maintained by using five machines if the head goes down to 36ft. —equivalent to a flow of about 3500 cubic feet per unit—when there is a greater flow than 3500 cubic feet and with a corresponding further reduction of the head all six units may be run if the same total output is to be maintained. As the maximum flood continues only for short periods and always occurs in seasons when the normal power requirements are smaller than in winter, it has not been found necessary to provide spare machines for the delivery of full power at these times.

Several alternative proposals for using vertical as well as horizontal turbines were considered, but double horizontal turbines were chosen. They were designed for 12,000 horse-power at 107 revolutions per minute for a net head of 40ft. This arrangement was not only the least expensive but also required the shortest power station, a factor which is of great importance, as the space available for the station is very limited.

Double horizontal turbines in open flumes with inlets in an axial direction from one end and the discharge pipe conveyed in the opposite direction, under the generator room, also in an axial direction, gave suitable dimensions and comparatively simple construction. The same arrangement has long been used for smaller sizes of power station, and has recently been developed for large turbines also, especially in Sweden. The largest installation with this arrangement which has hitherto been built is the Untra power station on the Dala River, belonging to Stockholm. With double horizontal turbines of such large dimensions as in the present case there is no especially great difficulty in providing access to such bearings as may have to be placed under water. Thus even if a bearing be placed in the middle of the turbine casing, it is quite possible to make it accessible while the turbine is running.

FIG. 1—THE RAANAASFOSS HYDRO-ELECTRIC POWER STATION

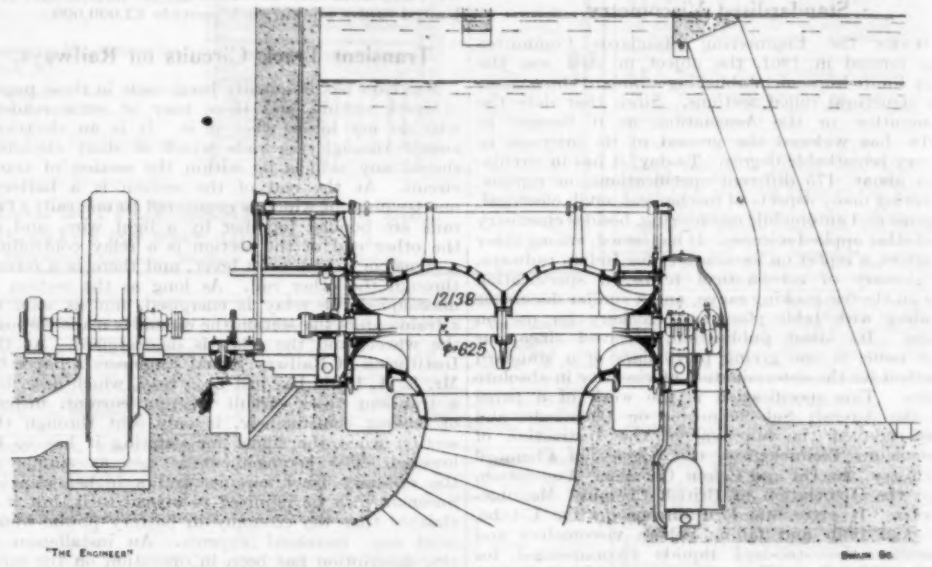


FIG. 2—SECTIONAL ELEVATION OF 12,000 H.P. KARLSTAD TURBINE

At Raanaasfoss the turbine flumes are placed side by side on the Eastern bank, and form a part of the dam across the river. In front of the inlets to the flumes are placed coarse screens, which work in channel iron guides and can be lifted up. The same channel iron guides may also be used for putting in stop logs in case it is desired to empty the turbine flumes. The intake gates, two for each flume, are placed behind the coarse screens. They are 15ft. wide and 36ft. high, and are provided with fixed rollers. Behind the gates are fine screens with 1¼in. openings between the bars. When designing the bars for the fine screens, consideration was given to the possibility of heating them electrically. A brick house is built over the gates and screens to protect them from frost in the winter. The house is heated by hot air from the generators. A 25-ton gantry crane runs over all the turbine flumes, and on the land side it can be run out over the railway track. The turbine shafts pass through the wall into the power-house, where they are coupled direct to the generators. Below the intake ends of all the turbines there is an inspection gallery, from which there is access to the various turbine bearings. The governors are placed in the generator room near the upstream wall. A duct in which the oil pipes are laid runs under all the governors.

Of the six turbines installed, Nos. I. to III.—counting from the dam—were built by the Aktiebolaget Karlstads Mekaniska Verkstad, Verkstaden Kristinehamn, which is associated with Boving and Co., Limited, London; while turbines Nos. IV. to VI. were supplied by the firm of J. M. Voith, of Heidenheim. Both manufacturers were faced by a difficult problem in that the proposed turbines would be larger than any double horizontal turbines built up to that time. Both were given a free hand as regards the choice of the type of the regulation system and the position of the bearings. It was, however, specified that both types should suit the inspection gallery and the pipe ducts, and also that the appear-

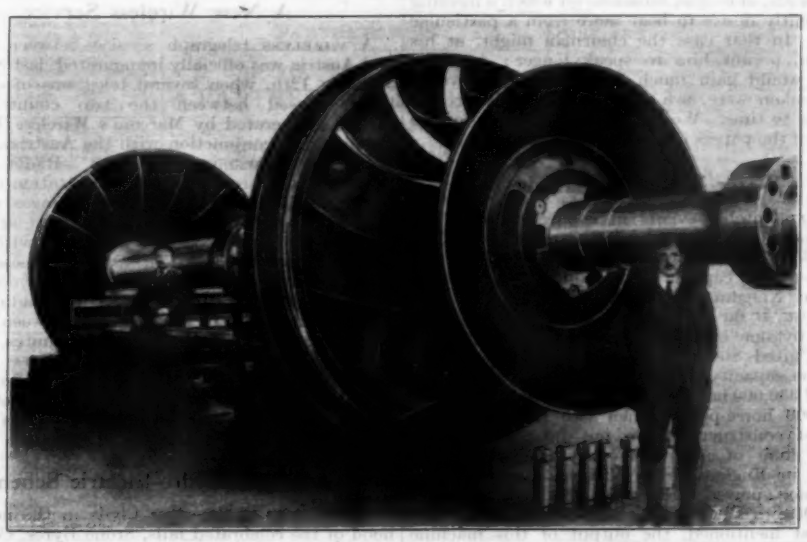


FIG. 3—RUNNER OF 12,000 H.P. KARLSTAD TURBINE

* Being a part of the official account of the whole installation, prepared by the Akershus Elektricitetsverk.

ance of the machinery from the generator room end should be as nearly similar as possible. Although the firms worked independently of each other, each firm utilising its own special experience, the weights of the machines delivered were surprisingly similar, of view of efficiency. The appearance of the runner is shown in Fig. 3.

The turbine casing is of the type previously used at the Untra power station, which was designed after exhaustive trials in the Verkstaden testing station.

FIG. 4—GOVERNOR FOR 12,000 H.P. KARLSTAD TURBINE

the Kristinehamns turbines with governors weighing 234 tons each and Voith's 226 tons.

All the turbines were ordered for an output of 12,000 horse-power for a net head of 40ft. at 107 revolutions per minute, and a consumption of about 3200 cubic feet of water per second. The highest These trials showed that from the point of view of efficiency the design of the casing is of equal importance with that of the runner. Further, these trials showed that by making even very small alterations in the shape of the casing the efficiency might be lowered 5 or 6 per cent. To facilitate the erection is no bearing inside the casing, the shaft had to be of very large diameter in order to reduce deflection. The distance between the runners is 24.6ft.

The bearing shells have spherical seats. The thrust is hydraulically balanced so that the bearings could be made plain, that is, without collars. Owing to this, and also to the capacity for self-alignment of the shells, the bearings are very reliable, and their temperature does not exceed 30 deg. Cent. even without water cooling, though a cooling arrangement is incorporated in the design in accordance with the terms of the specification. The bearing at the intake end is placed in a chamber to which access can be had through a vertical shaft from an inspection corridor which runs under the ends of all the turbines.

An ordinary chain block, hung from a ring above the bearing, is used for dismantling these bearings, while for those at the generator room end there is a block attached to a carriage which runs on an I girder. The girder can be moved and attached to the various wall frames above different bearings. The packing round the turbine shaft, where it passes through the covers of the control gear, is of a labyrinth type patented by the Verkstaden Kristinehamn. The control gear, by which the water supply to the runners is adjusted, is designed for inside regulation; that is to say, the regulating mechanism is situated in the flume, but the vane pins, as well as the regulating ring, can be lubricated from the machine room while the turbine is running. For these turbines inside regulation is much simpler than outside regulation, and has proved to be very reliable and durable when lubrication can, as in this case, be effected whilst running.

As an example, it may be mentioned that the control gear of the large 12,500 horse-power turbines of the Swedish Government power station at Trollhättan, which have been in practically constant use for about thirteen years, have shown so little wear that as yet not a single bush has had to be replaced. For use with higher heads and lower specific speeds, however, the Verkstaden Kristinehamn employs outside regulation, since, with these machines, the velocity of the water in the control gear is greater and the height of the guide vanes

FIG. 5—CURVES SHOWING RESULTS OF GOVERNING TESTS OF KARLSTAD TURBINE

guaranteed efficiency was 85 per cent. at about 10,500 horse-power. With a head of 43.3ft. or possibly 46ft., this would correspond to 13,400 or 14,600 horse-power respectively and a consumption of about 3500 cubic feet water per second. In order to obtain the best possible type of runner, and in view of the terms of the contract, both firms carried out a number of experiments in their testing stations with model runners of 25½in. to 27½in. diameter. These runners were tested in half casings of the same shape as that which would be used in the installation. These tests were supervised by the purchaser, who had the right to demand, for additional payment, the continuance of the trials, even after results had been obtained which satisfied the conditions of the contract. As will be seen from the efficiency tests, which were ultimately carried out on the finished turbines, the making of experimental runners was of the greatest utility and value.

TURBINES NO. I. TO III., SUPPLIED BY THE AKTIEBOLAGET KARLSTAD MEKANISKA VERKSTAD, VERKSTADEN KRISTINEHAMN, SWEDEN.

As mentioned above, the turbines are of the double horizontal type, as will be seen from the sectional drawing given in Fig. 2. In order that the reader may form an idea of the size of the turbines it may be stated that the distance between the two bearings which support the shaft is 40ft., and that the weight of the turbine units with the governor is 234 long tons.

The runners are made with buckets of steel plate of ship quality cast into a shroud and a hub of the best Swedish cast steel. They have a maximum diameter of 11ft., and at the time they were made they were, doubtless, the largest runners ever made with plate buckets. Since then the Kristinehamn works have made runners of this type with a maximum diameter of 16.5ft. for the Russian Government, but in that case the buckets were cast into cast iron shrouds and hubs. Steel plate was chosen as the material for the runner buckets mainly because steel plate has been found to have a greater resistance to wear and tear than cast steel, which is a very important factor in high-speed turbines and, further, steel plate has a smoother surface, which is important from the point of the casing of the Raanaasfoss turbines, it is divided into sixteen parts, which are bolted together with strong flange joints—see Supplement. The whole is mounted on a foundation ring, oval in plan, and divided into four parts. The casing, together with the foundation ring, weighs 64.9 long tons. is less, so that guide vane links cause more obstruction to the flow of water.

In each apparatus at Raanaasfoss there are twenty cast steel guide vanes, and any vane can be removed without disturbing the other parts of the apparatus. The regulating ring to which all the vanes are

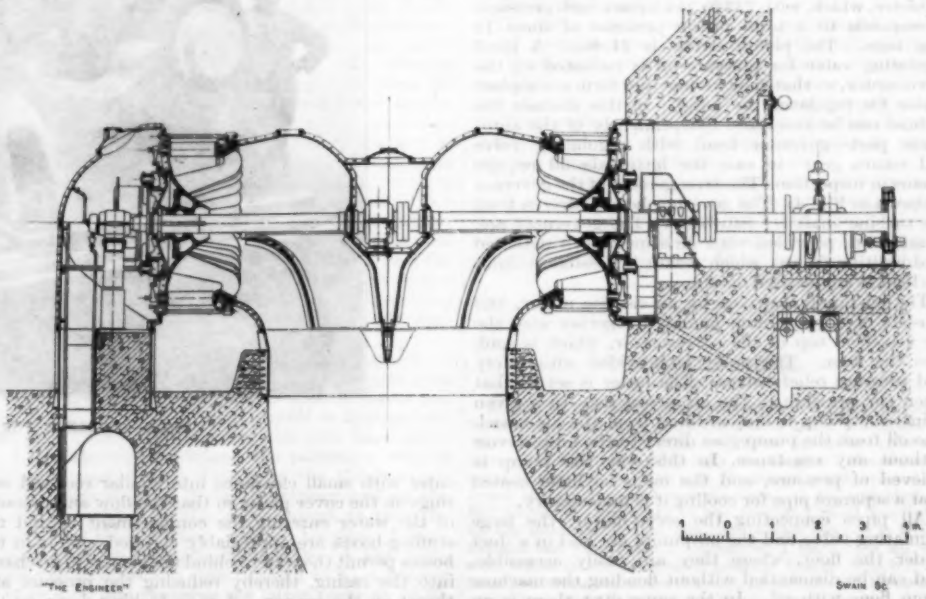


FIG. 6—SECTIONAL ELEVATION OF VOITH 12,000 H.P. TURBINE

The turbine shaft is of considerable dimensions. Its total length is 58.5ft., and it is divided into three parts, which are connected by means of forged flange couplings, of which one is situated in the middle of the casing. The shaft is hollow throughout its whole length, and is supported on two bearings only, the distance between which is about 40ft. As there connected by means of links and pins, is made of cast steel, and is mounted on rollers which are fitted into an annular space in the regulating ring. To protect and lubricate the rollers, this space is filled with grease which can be forced in from the outside. The governor shaft for operating the regulating ring is situated right above the centre of the turbine,

and it is connected with both regulating rings by means of levers and links. In order to eliminate the torsion in this shaft, one crank is mounted a little in advance of the other, so that, when shutting down, both sets of guide vanes will be properly closed. Owing to this arrangement and to good workmanship, the closing of the vanes is so complete that the turbines stop revolving in a comparatively short time without the use of a brake.

To improve the flow of water to the lower part of the guide ring, the bottom of the flume under the latter is made spiral in shape, that shape having been used previously at Untra with good results. The covers of the guide ring at the generator room end, and of the chamber for the bearing on the intake end, are made of cast steel. The guide ring and the casing to which they are bolted are, on the other hand, made of cast iron.

In an opening in the generator room wall there is a strong wall box, which is fitted to the guide ring cover. In this wall box the ring lubricated bearing is placed. The opening is lined inside with steel plates, and between the plates and the concrete there is a drainage space to carry off any possible leakage of water through the concrete. This construction has proved to be very good, as the usual damp patches around the openings are thereby avoided. The design of the turbines may be seen from the illustrations in the Supplement.

Each turbine has its own governor, which can be run independently of the others, but the governors may also be coupled together by means of interconnecting pipes, so that they all may run on the same oil system. Each governor consists of three main parts—servo-motor, governor head and oil pump. The servo-motor is placed under the centre of the turbine shaft, with its cylinders arranged below the floor level. The cylinders are 15.8in. in diameter, which, with 213 lb. per square inch pressure, corresponds to a total piston pressure of some 19 long tons. The piston stroke is 21.6in. A hand regulating valve for pressure oil is mounted on the servo-motor, so that the two together form a complete device for regulating by hand. In this manner the turbine can be run quite independently of the automatic part—governor head with regulating valve and return gear—in case the latter should require repairs or inspection. The arrangement of the governor is shown in Fig. 4. The governor head is driven from the turbine shaft by two belts. The governors are, in addition, provided with Kristinehamn's patented load-limiting device, which makes it possible to limit the load to any desired maximum.

The oil pump is driven by an electric motor, and consists of a gear pump mounted together with the air vessel on top of the oil reservoir, which is sunk into the floor. The pump is provided with safety and pressure relief valves. The latter is set so that when the pressure in the air vessel rises to a given point, the pump is disconnected from the air vessel. The oil from the pump goes direct to the oil reservoir without any resistance. In this way the pump is relieved of pressure, and the oil is so little heated that a separate pipe for cooling it is unnecessary.

All pipes connecting the servo-motor, the large regulating valve and the oil pump, are laid in a duct under the floor, where they are easily accessible, and can be dismantled without flooding the machine room floor with oil. In the same duct there is an emptying pipe common to all the governors through which the oil can be emptied to a tank at a lower level under one end of the station. From this tank the oil can be forced into any of the governors. To facilitate synchronising and dividing the load between the individual machines, the governors are provided with electric speed adjustment in the usual way.

Fig. 5 shows the result of the governor test. In these tests the load was thrown on and off by means of an oil switch.

TURBINES NO. IV. TO VI. SUPPLIED BY J. M. VOITH, OF HEIDENHEIM-ON-BRENZ.

As mentioned above the turbines are of the twin horizontal type, as illustrated in Fig. 6. The large size of the turbines will be apparent when it is borne in mind that the overall height from the bottom of the base ring to the highest point on the turbine is 20½ft., and the total overall length 43.7ft The total weight of turbine and governor is 226 tons, as stated before.

FIG. 7—VOITH 12,000 H.P. TURBINE FROM GOVERNOR END

As far as water consumption is concerned, these turbines are the largest ever constructed in Germany, a maximum volume of 3500 cubic feet per second passing through each turbine at full load and 46ft. head. The runners have steel plate vanes, 17 mm. thick, cast into the hub and shroud, which are of cast steel. The runner hubs are bolted to flanged bosses, keyed on the main shaft. The runners are 7ft. 6in. in diameter at the hub and 10ft. 11in. at the exit end. The bosses are shaped to form a good passage for the water at the discharge end, and at the opposite side are provided annular grooves and tongues which enter with small clearance into similar recessed seal rings on the cover plate, so that the flow and pressure of the water entering the compartment behind the stuffing-boxes are appreciably checked. Slots in the bosses permit the water behind the runner to discharge into the casing, thereby reducing the pressure and thrust on the runner. A view looking down on the turbine and showing one of the runners in position is given in the Supplement, as are also views showing a turbine in different stages of erection in the maker's works.

The guide vanes are steel castings 41½in. wide with their operating mechanism lying entirely outside the water space, so as to be accessible for inspection and lubrication. Grease cocks, conveniently arranged outside, facilitate efficient lubrication of both guide vane journals during operation. The guide vane spindles are journalled in two bearings, both provided with delta metal bushings and lubricated by separate Stauffer cups. The bearing in the cover plate receives the grease through an inclined hole in the body of the box, while the rear bearing is supplied with grease through a hole drilled centrally in the spindle and guide vane throughout its entire length. The grease cocks are fixed on the control gear cover plates, one of which lies in a recess in the station wall facing the generator room and the other in an attendance compartment on the upstream side of the turbine. Iron ladders provide convenient access to the grease cocks at both places.

The following arrangement, patented by Voith, is introduced to facilitate easy removal of each and every guide vane. The guide vane pivot bearings in the casing side are split, and one half of the bearing can be removed by taking off a segment in the crown plate. The stuffing-box on the other side of the guide vane is drawn out over the spindle, after taking off the arm. Thereafter the guide vane can be slid out towards the casing side. This arrangement does away with the cumbersome detachment of all guide vane arms, loosening of bolts and removal of guide apparatus cover necessary with other designs of control gear with outside regulation, whenever a guide vane has to be taken out.

The main shaft, which has a total length of 59ft., a maximum diameter of 18½in. and a diameter of 10½in. at the thrust bearing, is divided into three parts, so that during erection, each part—two carrying the runners—can be conveniently got into place by the crane before the upper halves of the casing are lowered into position. The bearing at the shaft end is a collar thrust bearing, carrying at its end a cooling attachment for injection of water into the end of the hollow shaft. The intermediate bearing is arranged in the casing, as may be seen in Fig. 6. As a result of providing this bearing a maximum bearing distance of about 21½ft. is obtained, which would without it have been 41ft. With the form of casing adopted by Voith it is easy to arrange for a water-tight compartment around the bearing, and the smaller bearing distance results in small shaft deflection, notwithstanding the moderate diameter of the shaft.

For the purpose of giving the water a stream line motion, dividing guide plates are placed in the path of the water immediately below the shaft and riveted to the cast iron walls. Each casing is split—horizontally and vertically—into four parts, which are flanged and bolted together. They are huge castings, such as only a well-equipped foundry could undertake to make. The upper parts of the casing are provided with manholes and bosses, reinforced by ribs, for lifting eye bolts. Underneath the casing is arranged a cast iron base ring of about 17ft. 6in. by 17ft. 6in. free area imbedded in the concrete flume, which is reinforced by round iron bars.

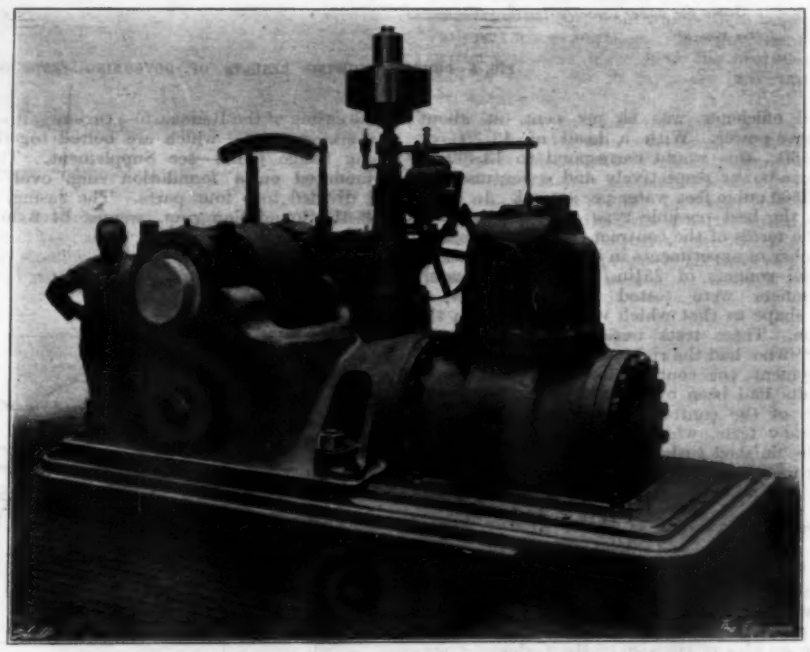


FIG. 8—GOVERNOR FOR 12,000 H.P. VOITH TURBINE

The intermediate bearing is surrounded by a water-tight cast iron chamber, built into the casing and accessible through an inclined entrance tunnel leading to a duct in the concrete foundation, which in turn is connected with a common inspection duct underneath all the turbines. From this duct a vertical shaft leads to the thrust bearing chamber, so that all bearings and regulating parts on that side of the turbine are readily accessible to the attendant during operation. The guide vane arms sit on the slightly tapered spindle ends, and are, as usual, connected by links to the two large shifting rings, which

derive their motion through connecting-rods from double arms on the regulating shaft. All the links are bronze bushed, and have steel pins, which can be lubricated and inspected during operation. The regulating shaft has diameters of 12in. and 16½in., and is made in two pieces, joined by a sleeve coupling. The front end is journalled in the governor proper and carries a forked arm, directly connected with the servo-motor piston. The governor has a working capacity of 100,000 foot-pounds.

The pilot-valve-actuated regulating valve is fixed on the servo-motor cylinder. Above the crosshead guide is a column which carries the enclosed governor head containing flyweights which revolve—practically without friction—on knife-edge pivots and are connected by thin steel ribbons with the sleeve. On the side of the column is a housing containing the compensating relay and a device for varying the degree of sensitiveness of the governors.

The difference in speed between full load and no load can by means of this device be reduced to zero or—if required—be made negative. The compensating gear also includes a device by which the maximum gate opening and hence the maximum output of the turbine can be limited. This device consists of an adjustable connection—acting only in one direction—between the fixed part of the compensating relay and a stop which prevents additional travel of the governor head sleeve. The purpose of this device is to facilitate prevention of overloading the generators at increasing head, but the device is also useful when running in parallel with other plants and, furthermore, very useful during load and efficiency tests, since the turbine by its means can be given a constant gate opening during the whole test. The governor is, in the usual way, equipped with electric switchboard control for synchronising and for distributing the load between the units directly from the switchboard. The governor head is also, as usual, belt driven by a rubber belt. For the geared pressure-oil pumps, however, herring-bone gear drive, entirely enclosed, has been resorted to because of considerations of space and of the desire to obtain the highest degree of safety and reliability in operation.

An automatic cut-off valve permits the pump to deliver pressure oil only as long as the pressure in the accumulator is below the limit set, about 213 lb. per square inch.

In the pump oil sump is provided a cooling spiral. The accumulator is placed below the floor in a checker-plate covered pit on the side of the main duct underneath the governors, in which, also, the oil pipes are arranged. The accumulator requires no attention, and underneath the floor it does not block the passage-way around the turbine or obstruct the view in the power station. Fig. 7 shows the turbine seen from the generator side with governor and pump erected at the works; and Fig. 8 shows the governor alone. Fig. 9 shows governing results obtained at the acceptance test. At these trials the load was applied and cut off by means of an oil switch.

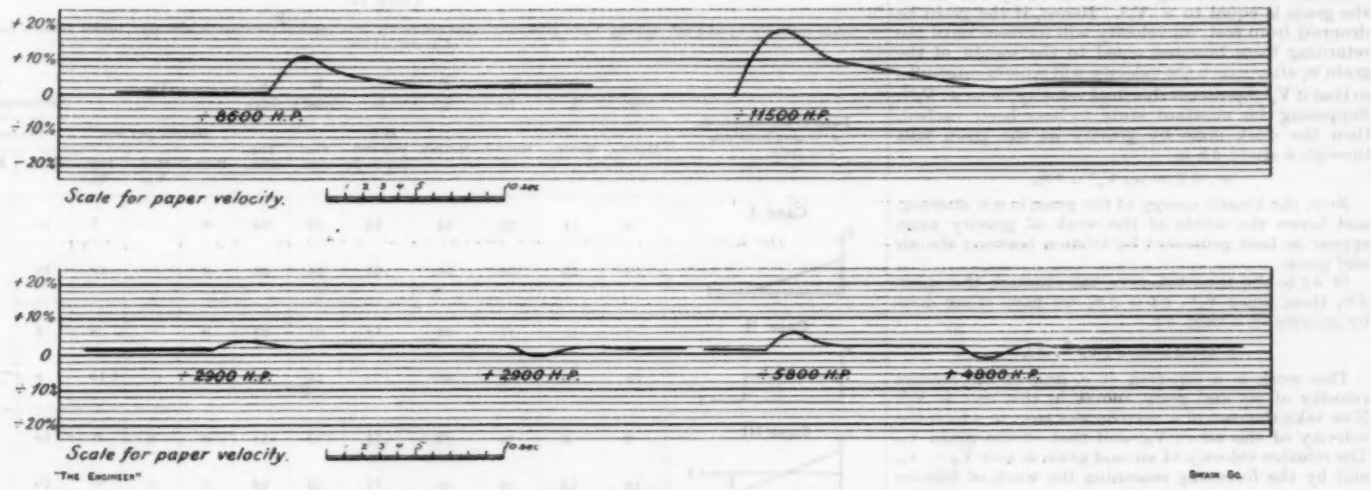


FIG. 9—CURVES SHOWING RESULTS OF GOVERNING TESTS OF VOITH TURBINE

The Winter Train Services in France.

THIS winter the French railway companies have retained many of their summer trains and put into operation certain new and accelerated services.

The Etat is a summer line to a large extent, but the Havre services are maintained at 1 h. 50 min. for Paris to Rouen and 1 h. 11 min. on to Havre. On the Brest line two trains are booked from Chartres to Le Mans in 1 h. 40 min. and one up in 1 h. 36 min., 76.4 miles.

On the Paris-Orleans Railway the accelerated service of the Sud express is maintained, 20 min. being gained to Bordeaux, and the night *luxe*, *rapide* leaves at 9 a.m. to arrive in Paris at 9.30 p.m., a later departure by 15 min. and an earlier arrival by 30 min.

The night *rapides* are much as last year, except for starting later and saving the time on the journey; but this year the 5.35 p.m. leaves at 7.5 p.m. and is exclusively composed of places *de luxe*, sleeping cars, *lits salon*, and *salon avec draps*—as when the "Nice Express" No. 17 started—and gains 45 min. on its timing. The through first and second-class train from Calais to Ventimiglia is continued, and on the up journey starts 50 min. later and arrives in London at 5.10 p.m. instead of 7.30 p.m., catching the first boat out of Calais. The Calais train *de luxe* starts 5 min. later in spite of a 9 min. earlier arrival at P.L.M. station, and arrives at the same time at Nice, but the stop at Macon is taken out and the great novelty is that both up and down no passenger stop is shown at Marseilles, the new war-time direct junction line to the Toulon line, which avoids Marseilles station, being used.*

The day first and second-class *rapides* have now no booked stop at Macon and run the 122.4 miles from Dijon to Lyons Perrache in 2 h. 30 min. down and 2 h. 38 min. up. The 7.5 p.m. *rapide de luxe* and the 7.30 p.m. Calais-Mediterranée *luxe* runs from Dijon to Lyons-Brotteaux without the passenger stop at Macon up and down. This year the Calais-Ventimiglia *rapide* stops at Lyons-Brotteaux and on the up run is enabled by this arrangement to pass the Narbonne, Cette, Nimes *rapide* between Lyons-Perrache and St. Germain-Mont d'Or. A new train starting from Strasburg runs through to Nice, leaving at 12.40 p.m. and reaching the latter point at 10.35, *vid* Mulhouse, Belfort, Besançon, and Lyons.

Many of the intermediate timings are better than the total time would lead one to suppose. One train is booked from Macon to Lyons, 44.7 miles, in 53 min., or 50.6 miles per hour, and the two-hour booking from Dijon to Laroche is retained from this summer, but in many cases the easy 74.6 miles from Avignon to Marseilles take 1 h. 50 min. to 2 h. Through Laroche, between 9 p.m. and 8 a.m., there are no less than twenty-eight *rapides*, both up and down, while in the twenty-four hours, including directs, there are no less than fifty.

On the Nord the accelerated Paris to London services are maintained, while the winter Swiss services are reinstated, with the remarkable booking on the up journey of 64 min. for the 59.6 miles from Amiens to Etaples, or 55.8 miles per hour. While the *luxe* from Calais is allowed 1 h. 51 min. to Amiens for the 103.7 miles over a by no means easy road, or 56.1 miles per hour, both up and down. On the Lille and St. Quentin lines the services are unchanged, while the Paris-Brussels non-stop trains in both directions are continued; but, of course, the load is light and strictly limited owing to the absence of water troughs.

On the Est the accelerated Nancy-Strasburg trains are maintained, Chalons-sur-Marne, 107.49 miles, being reached by the fastest train in 1 h. 59 min., and in a recent run over this stretch 13 min. were gained. The Rheims trains are accelerated from that point to Charleville and Sedan, as the permanent way is again in order. The Paris-Belfort-Basle trains now run to Troyes, 103.7 miles, in 1 h. 58 min., or 52.7 miles per hour, and up in 1 h. 51 min., or 56.1 miles per hour; but the Boulogne and Calais-Basle trains are again slower timed than the others, though an explanation can be found in their loading and in their following less hardly timed trains. The 59 miles from Chaumont to Troyes are booked at 63 min., or 56.1 miles per hour.

On the Alsace-Lorraine system no changes of note have taken place, but the London-Ostend-Brussels-Strasburg-Milan trains are accelerated by 1 h. 37 min. to Basle and 2 h. 40 min. to Milan from London, and during the summer a through train from Amsterdam to Basle ran over this system.

The cross-country services are maintained and in many cases increased. Lille has now through carriages to Ventimiglia *vid* St. Quentin, Laon, Chaumont, and Dijon; Calais to Basle *vid* Lille, Laon, Chaumont, and Belfort; while Amsterdam has a through coach to Ventimiglia *vid* Paris-Nord and the P.L.M., and the train *de luxe* from Vienna to Cannes is again running three days a week.

In the cases where no changes are made the services are either excellent or relaying subsequent to the war is being carried out, while the train loads are heavy, and over such long runs a sufficient margin has to be allowed to enable delays to be regained.

* On these trains the engines now run from Avignon to Nice without change, both up and down, a distance of 213 miles, and have no passenger stop between Avignon and Toulon, 114.9 miles. The building of the new Var Bridge at Nice is complete, and this winter for the first time the big 4-6-2 Pacifics run the whole way from Paris to Nice.

BESSEMER STEEL.

DR. H. C. H. CARPENTER gives the following remarkable facts about Bessemer converters in a letter published in *Nature* of January 12th:—"Your reviewer (*Nature*, December 8th, page 831) asks me to give 'the date of construction of the last new Bessemer plant erected in Great Britain for steel manufacture.' I am indebted to Mr. Lloyd, the secretary of the Iron and Steel Institute, for the information that new plants were erected in Great Britain last year (1922). Moreover, I learn that all the steel works in the devastated areas in France, which have been reconstructed since the war, have installed Bessemer converters, and that these are larger than those previously in use. Thus far, twenty converters, each of 30 tons capacity, have been constructed, and put into operation. Finally, may I say that large quantities of steel are now made by a process in which the metal is first refined in Bessemer converters, and afterwards, at still higher temperatures, in electric furnaces, which permit the reduction of phosphorus and sulphur to very small quantities, and the manufacture of high-quality steels? The Bessemer process is still very much alive."

Pneumatic Grain Elevators.

No. II.*

By Professor W. CRAMP, D.Sc., and A. PRIESTLEY, M.Sc.

(5) Work of the Pneumatic Conveyor.

As the air passes up the pipe of the conveyor, itf pressure and volume change, and each kilogramme o. air does a definite amount of work. If the air pump of the conveyor were thermo-dynamically perfect the amount of work necessary to pump 1 kilo. of air through the system would be exactly equal to the total work done by the atmosphere on the contents of the pipe. The efficiency of the conveyor depends therefore on the fraction of this total work which it is possible to turn into useful mechanical work done on the grain, and we must now consider what determines the value of this fraction.

(6) Useful Work Done by Air on Grain.

Let W = increase of energy of grain per second.

Then $$W = L\left(\frac{V_f^2}{2g} + S_f\right) \quad . \quad . \quad . \quad (13)$$

This is the total mechanical work done on the grain per second. It should be noticed that the production of kinetic energy $L\frac{V_f^2}{2g}$ cannot as a rule be regarded as *useful* work, since this energy has usually to be destroyed again when the grain is brought to rest in the receiver, being dissipated in the form of heat. Strictly, the only useful form of work done in a vertical elevator is the work of lifting the grain, $L \cdot S_f$.

(7) Work of Friction Between Air and Grain.

Let a single grain be allowed to fall freely through still air. From what has been said above, it will be seen that the retarding force exerted by the air on the grain is equal to $a \cdot V_g^2$. Hence, if the grain be dropped from rest, its velocity will increase until the retarding force becomes equal to the weight of the grain w, after which the velocity will remain constant; so that if V_g^1 represents this final velocity, $w = a \cdot V_g^{1^2}$. Supposing this constant state to have been reached, then the work done by gravity as the grain falls through a space δS is—

$$w \cdot \delta S = a \cdot V_g^{1^2} \cdot \delta S.$$

Now, the kinetic energy of the grain is not altering, and hence the whole of the work of gravity must appear as heat generated by friction between the air and grain.

If δt is the time taken to fall through the space δS, then, since $V_g^1 \cdot \delta t = \delta S$, we have work done by gravity in a time δt—

$$= w \cdot \delta S = a \cdot V_g^{1^3} \cdot \delta t.$$

This work is a function of a, and of the *relative* velocity of air and grain, which in this case is V_g^1. Now take the case of a vertical elevator, in which the velocity of the air is V_a, and that of the grain V_g. The relative velocity of air and grain is now $V_a - V_g$, and by the foregoing reasoning the work of friction per grain in a time δt

$$= a\,(V_a - V_g)^2\,\delta t \quad . \quad . \quad . \quad . \quad (14)$$

This work is now being done by the air instead of by gravity, and must be included in the total work done by the air during expansion.

Since the number of grains passing per second is $\frac{L}{w}$, we have, if R = total work of friction done by the air per second—

$$R = L \cdot \frac{a}{w}\int (V_a - V_g)^2\,dt \quad . \quad . \quad (15)$$

for air at atmospheric density.

(8) Other Work Done by the Air.

We shall neglect the work done by the air in lifting and accelerating itself, as this has been shown to be small. We shall also neglect for the moment the work of friction of the air against the pipe, which does not become important unless the velocities are high and the pipe diameter small.

The friction of the grain against the pipe will also be neglected for the present. As will be seen later, it does not assume serious proportions except at high velocities.

Making these assumptions, we have—

Total work done by the atmosphere per second on the contents of the pipe

$$= W + R \quad . \quad . \quad . \quad . \quad (16)$$

(9) The Efficiency of a Pneumatic Elevator.

Let E (total) be the ratio of the total energy appearing in the grain to the pump work done to produce it. Then E (total)

$$= \frac{W}{W+R} = \frac{L\left(\frac{V_f^2}{2g} + S_f\right)}{W+R} \quad . \quad . \quad (17)$$

Let E (lift) be the ratio of the energy required to *lift* the grain to the total pump work. Then E (lift)

$$= \frac{L\,S_f}{W+R} \quad . \quad . \quad . \quad . \quad (18)$$

* No. I. appeared January 11th.

It will be seen that while E (total) is the mechanical efficiency of the vertical pneumatic elevator, E (lift) may be described as the useful efficiency, for the kinetic energy produced in the grain is not generally made use of. Whichever efficiency we consider, it is obvious that we should aim at reducing R, the work of friction, as much as possible.

We may write equation (15)

$$R = L\,\frac{a}{w}\int \frac{(V_a - V_g)^3}{V_g}\,dS,$$

since $$\frac{dS}{V_g} = dt,$$

and eventually $V_a - V_g$ approximates to the constant value $\sqrt{w/a}$; hence in the limit we have $R = C\int \frac{dS}{V_g}$, where C is a constant. So that for any given length of pipe R becomes smaller without limit as V_g is increased. If we could start with grain in which the kinetic energy were already produced for us, and had only to consider the efficiency of conveying that grain, we should choose as high a grain velocity as possible—not forgetting, however, that in the expression for R we have neglected friction of grain and air on the pipe. But as most pneumatic conveyors have to produce the kinetic energy in the grain as well as to convey the grain, we should find that though we had diminished R by choosing a high V_g, we had at the same time increased W, and we know that the total pump power P = W + R. There will, in fact, be some intermediate value of V_g which will make W + R a minimum.

(10) Maximum Theoretical Efficiency for a Vertical Elevator.

We know that the force exerted upon a grain by the air is a function of $(V_a - V_g)$. By using a pipe of varying diameter, the air velocity V_a may be made to vary from point to point in the pipe, and the acceleration and velocity of the grain may be made to follow any desired law as the grain passes up the pipe. It is therefore important to find the conditions under which P, the total work done per second by the pump, will be a minimum, with such types of acceleration as might occur in practice.

Let x = the acceleration of the grain at any point;
V_f = the *final* velocity of the grain;
t_f = the time taken to pass through the pipe (seconds);
S_f = the length of the pipe.

The work of friction per second between air and grain is given by equation (15) (for air at atmospheric density). Now the force of the air on a grain is $a\,(V_a - V_g)^2$; and hence in a vertical pipe—

$$a\,(V_a - V_g)^2 = w\left(\frac{x}{g} + 1\right)$$

$$\therefore\ (V_a - V_g)^2 = \left\{\frac{w}{a}\left(\frac{x}{g} + 1\right)\right\}^{\frac{2}{3}}$$

Hence—

$$R = L\sqrt{\frac{w}{a}}\int_o^{t_f}\left(\frac{x}{g} + 1\right)^{\frac{2}{3}} dt$$

But the expression for the work per second done on the grain is $W = L\left(\frac{V_f^2}{2g} + S_f\right)$; so that from equation (16) the total work done per second is—

$$P = W + R = L\left\{\frac{V_f^2}{2g} + S_f + \sqrt{\frac{w}{a}}\int_o^{t_f}\left(\frac{x}{g} + 1\right)^{\frac{2}{3}} dt\right\} \quad . \quad . \quad (19)$$

We now select four alternative laws connecting x and t, and calculate for each the air and grain velocities which correspond with maximum efficiencies for specified lengths, and the values of those efficiencies. The four cases selected are:—

Case I.—$x = x_o\,(t_f - t)/t_f$. So that the acceleration starts with a value x_o and uniformly decreases to 0 when $t = t_f$.

Case II.—x = constant. Corresponding with a pipe decreasing in diameter from the nozzle upwards, the taper being just sufficient to maintain the acceleration.

Case III.—$x = x_o\,(1 - 2t/t_f)$, representing a modification of Case I., in that the taper is so calculated that the grain comes to rest at the end of the pipe, and all its kinetic energy is used in increasing its lift. This case represents the ideal in so far as the minimising of power is concerned, but it is a limit that is not attainable practically.

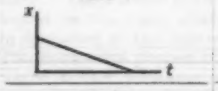
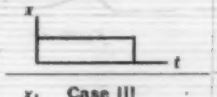
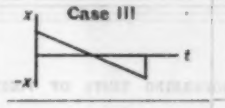
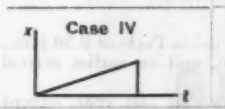
Case IV.—$x = x_f t/t_f$, so that the acceleration rises uniformly from zero to x_f.

Taking each of these equations in turn and substituting the appropriate value in equation (19), we can find the values of V_a, V_f, which will make P/L a minimum for selected valves of S_f. The process is laborious, but the results are given in Table II.

The air velocities V_a have been calculated on the assumption that the load is so small that the pressure of the air does not fall appreciably during its passage up the pipe, and that therefore the density and a do not change appreciably. In this case, the diameter of pipe will be inversely proportional to $\sqrt{V_a}$. Thus, to produce the acceleration of Cases I., II., and IV., the pipe would have to be appropriately tapered, being larger in diameter at the bottom than at the top. In Case III., on the other hand, the pipe diameter at the top would have to be so large that the air velocity V_a at that point would be negligible, both air and grain being brought practically to rest. Inventors have experimented with nearly all these pipe forms, and the conclusions given below show why their successes have been so meagre.

Table II.

Grain velocity V_g and air velocity V_a to give maximum efficiency in a vertical pneumatic elevator, under various conditions of acceleration.

Type of acceleration. x = acceleration. t = time.	S_f	$\frac{W}{L}$	$\frac{R}{L}$	$\frac{P}{L}$	$\frac{P}{L}$	E (total).	E (lift).	V_g			V_a (atmospheric pres.).		
	Metres.	Metres.	Metres.	Metres.	H.P. per ton per hour	Per cent.	Per cent.	Metres per sec. Bott.	Mid. V_m	Top. V_t	Metres per sec. Bott.	Mid.	Top.
Case I 	9	11	23	34	.13	33	26	0	—	7	10	—	14
	18	23	33	55	.21	41	32	0	—	10	10	—	17
Case II 	9	12	27	39	.14	31	23	0	—	8	8	—	16
	18	23	38	62	.23	38	29	0	—	10	8	—	19
Case III 	9	9	20	29	.11	32	32	0	6	0	10	13	0
	18	18	28	46	.17	39	39	0	8	0	10	16	0
Case IV 	9	14	33	46	.17	29	19	0	—	10	7	—	19
	18	25	48	73	.27	34	25	0	—	11	7	—	20

Conclusions from Table II.

The assumptions made in obtaining the results of Table II. should be kept in mind. The conclusions to be drawn are:—

(1) That long pipes are more efficient than short ones, though by no means in proportion to the length.

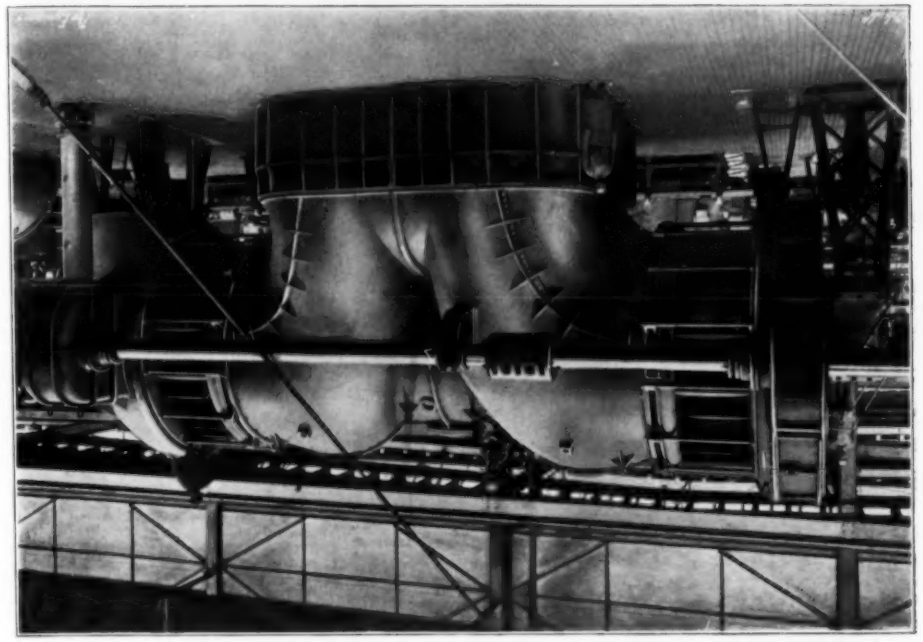
(2) The work lost in friction between air and grain is proportional to $\sqrt{\frac{w}{a}}$. Hence, a plant will work more efficiently with light and bulky material than with heavy and compact material.

(3) The least efficient type of acceleration is that of Case IV.

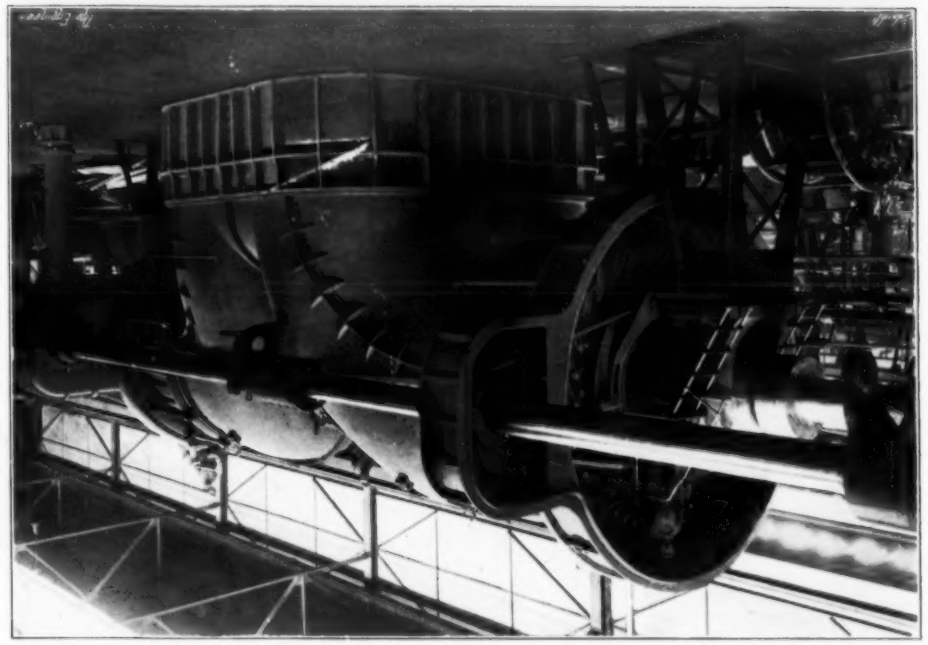
There is very little difference in efficiency between Cases I. and II. As would be expected, there is a slight gain in Case III., where the grain is delivered with no kinetic energy. But as this case could not easily be reproduced in any practical plant, the actual gain in efficiency of expanding the pipe at the end in order to reduce V_f (Mitchell's system) is certainly small.

(4) In Case I. the acceleration starts with some definite value and decreases to 0 at the end of the pipe. An examination of the velocity equation (2) will show that this approximates to the conditions holding in a vertical pipe of constant diameter. We shall therefore compare the tests of the experimental plant to be described below with the theoretical results of Case I., and it will be seen that the agree-

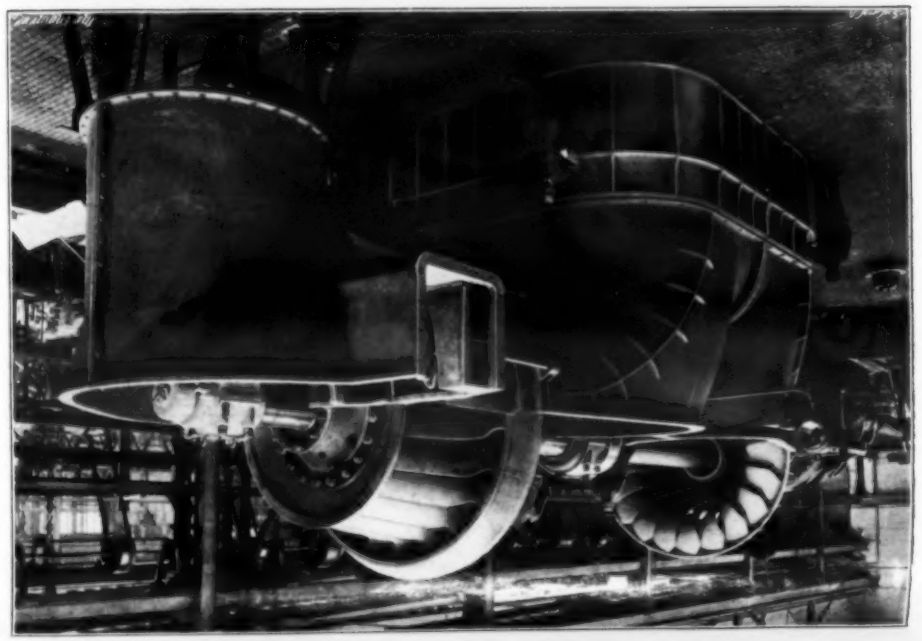
VOITH TURBINE COMPLETELY ERECTED IN SHOPS—SIDE VIEW



VOITH TURBINE COMPLETELY ERECTED IN SHOPS—FROM GENERATOR END



VOITH TURBINE—RUNNER PLACED IN POSITION IN SHOPS



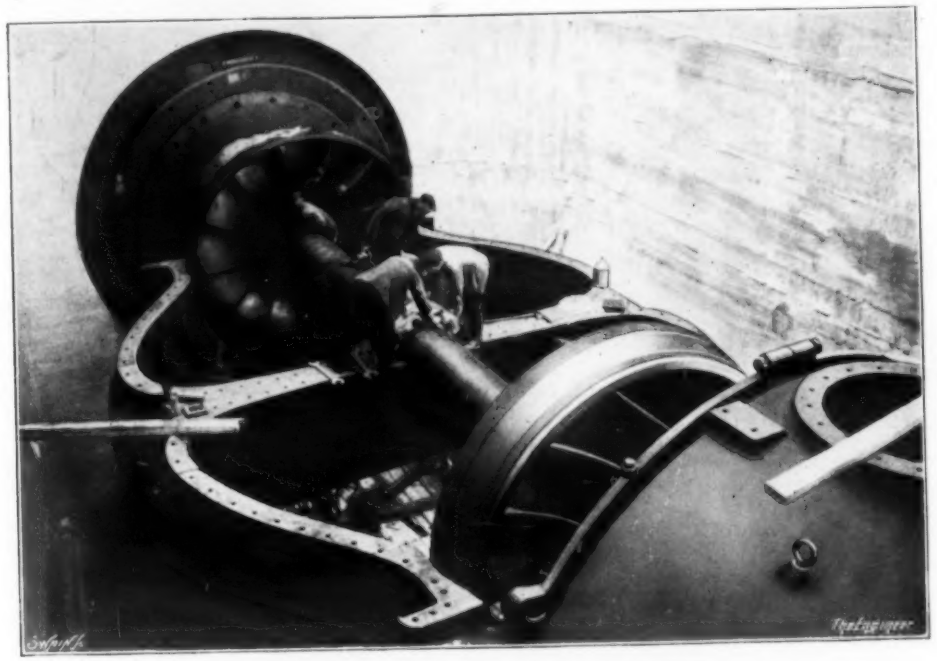
VOITH TURBINE ASSEMBLED—FROM GENERATOR END

KARLSTAD TURBINE—CASING AND CONTROL GEAR ERECTED

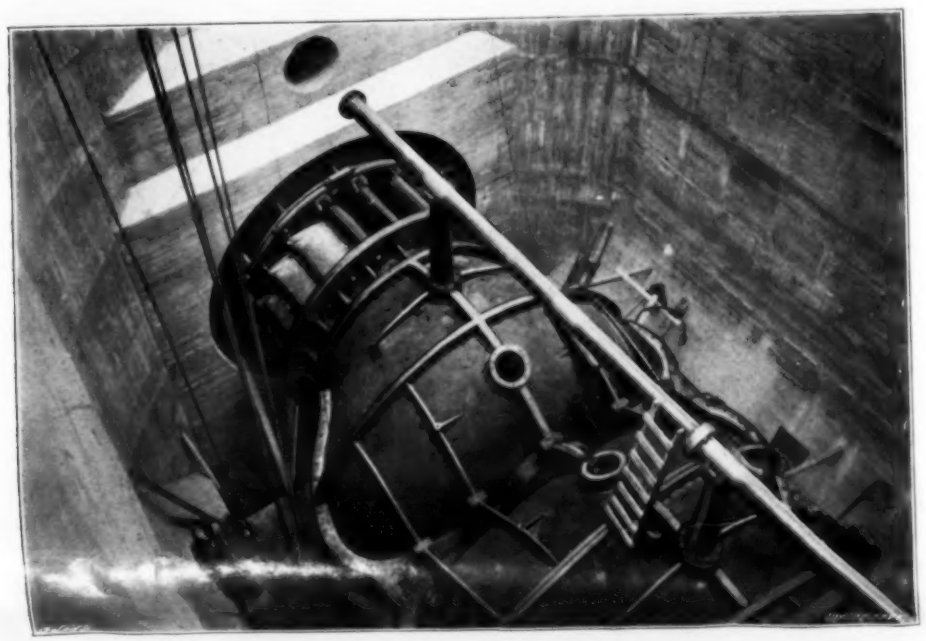
VOITH TURBINE NO. IV. BEING ERECTED ON SITE

TURBINES AT THE RAANAASFOSS HYDRO-ELECTRIC POWER STATION, NORWAY

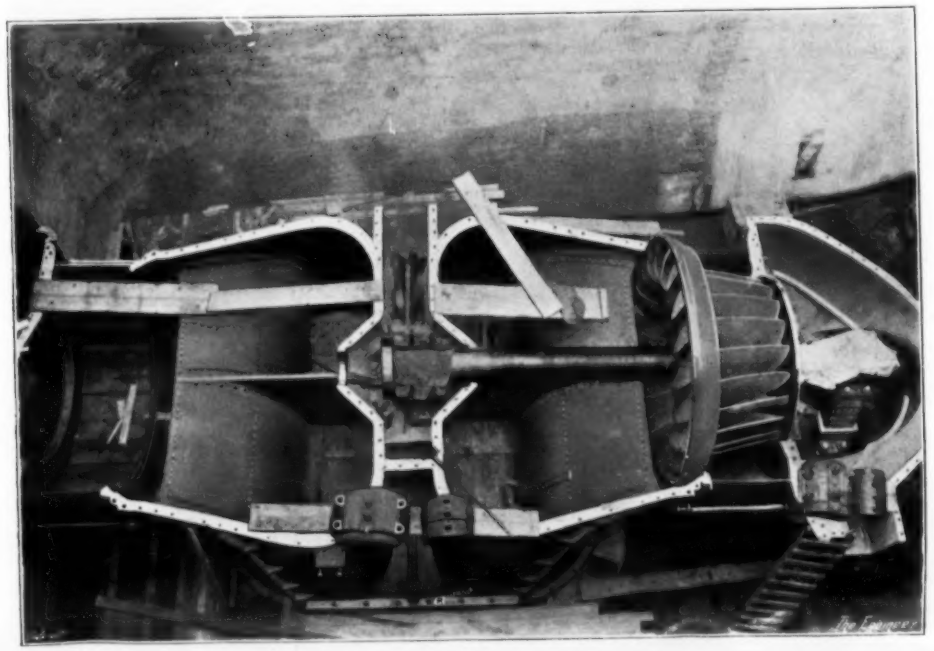
KARLSTAD TURBINE—LOWER PART OF CASING IN POSITION



PLACING RUNNER OF KARLSTAD TURBINE IN POSITION



KARLSTAD TURBINE—CASING AND CONTROL GEAR ERECTED



VOITH TURBINE NO. IV. BEING ERECTED ON SITE

ment is fairly close. From the investigation just made, it would appear that there is not much hope of increasing the efficiency of a plant above the values given in the Table under Case I.

(11) DESCRIPTION OF EXPERIMENTAL PLANT USED IN TESTS OF A VERTICAL PNEUMATIC ELEVATOR.

The principal parts of the apparatus used were taken from a small commercial plant, and are shown diagrammatically in Fig. 2 (*ante*). The air was drawn through the system by a reciprocating air pump driven by an electric motor. The vertical pipe to be tested was 9 m. long and 4.8 cm. internal diameter. Mercury U-tube gauges were provided to measure

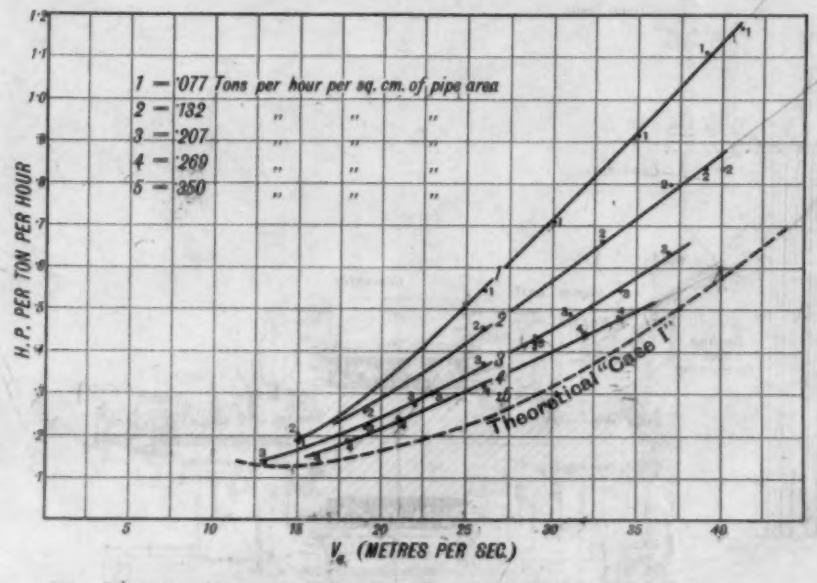


Fig. 4. Tests of Vertical Pipe, 9 metres long, 4·8 cms. diam. Relation between Horse-power per Ton per Hour and Air Velocity V_a at Top of Pipe. (Wheat, $\sqrt{\frac{w}{a}}$ = 7·35 met./sec.) Air Friction and Acceleration Losses included.

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the vacuum at the positions shown. The grain used in the tests was No. 1 Manitoba wheat.

For this grain the mean value of $\sqrt{\frac{w}{a}}$ was found to be 7.35 m. per second for air at atmospheric pressure. The grain was admitted at the nozzle of the pipe and passed with the air up the pipe. At the top both air and grain passed into the receiver shown in the figure. Below the funnel-shaped part of this receiver was a revolving drum discharger, driven by a belt from a pulley on the pump shaft. A more or less air-tight joint was made between the discharger and the receiver by means of a leather flap, kept in contact with the revolving drum by the pressure of the atmosphere. The air was drawn out of the receiver by the pump, passing on its way through a cloth filter to remove dust.

It was necessary to know the load L (tons per hour) passing up the pipe during each test, and this was determined as follows:—The stock of grain was contained in a box placed a little above the level of the nozzle of the pipe. In one side of the box, near the bottom, an orifice was made, the size of which could be adjusted by means of a shutter. With the orifice set to any given degree of opening, it was found that the weight of grain flowing from the orifice per second was fairly constant, so long as the level of the grain in the box above the orifice did not vary. Before beginning a test the orifice was set to some given opening, and the grain flowing from it in a given number of seconds was caught in a can and weighed. During the test a small hopper was placed so as to catch the grain from the orifice. The nozzle of the experimental pipe dipped into this hopper and drew all the grain from it as fast as the grain ran in from the orifice. The load L during the test was thus known. The calibration of the orifice was repeated after the test as a check.

During the test the grain falling from the receiver was returned at once through a chute to the grain box at the bottom, a continuous circulation of grain being maintained during the test.

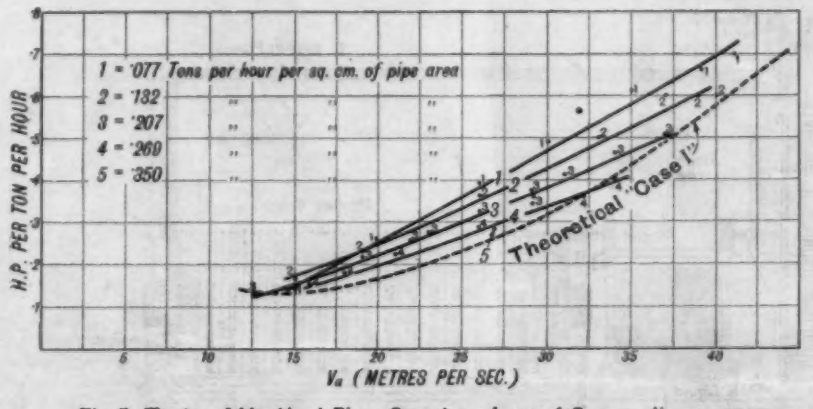

Fig.5. Tests of Vertical Pipe, 9 metres long, 4·8 cms. diam Relation between Horse-power per Ton per Hour and Air Velocity V_a at Top of pipe. (Wheat, $\sqrt{\frac{w}{a}}$ = 7·35 met./sec.) Air Friction and Acceleration Losses deducted.

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The measurement of the velocity of the air in the vertical pipe was effected by means of a Pitot tube. The Pitot tube could not be placed in any part of the pipe in which grain was passing, as its action would have been interfered with by the grain; it was also found that tubes placed in the current of grain became blocked in a few minutes. The Pitot tube was therefore placed in the pipe between the receiver and the filter, as shown in Fig. 2, and was frequently cleared of dust by being blown through with a bicycle pump. A disadvantage of having the tube in this position was that a correction had to be made for the air which leaked into the system through the receiver, so that special tests were run to measure this leakage, and the corrections are embodied in the results.

During the test it was necessary to vary the air velocity in the pipe in any desired manner. Some variation could be obtained by altering the speed of the motor driving the pump, but a wider range of velocity was required than could be effected by this method. An adjustable leak valve was therefore placed in the pipe near the pump, through which air could pass from the atmosphere directly into the pipe. When this valve was closed the air velocity in the vertical pipe was the maximum which the pump could produce; when the valve was wide open the velocity in the pipe was very small. As this leak valve was placed between the Pitot tube and the pump, the Pitot tube still recorded correctly the velocity of the air passing through the vertical pipe, after making the correction for the receiver leakage.

The calculation of the power involved was based on the assumption of isothermal expansion, since the error introduced thereby is negligibly small. The efficiency of the pump was known, but is not included, since that is a matter for the designer quite apart from the rest of the plant. The expression for power consumption is, then, for this plant:—

$$P = .00322\ P_1\ V_{a_1} \log_e \frac{p_o}{p_1} \text{ horse-power} \quad .(19a)$$

where V_{a_1} = velocity of air at the top of the pipe, in metres per second;
p_1 = pressure of air at the top of the pipe, in centimetres of mercury;
p_o = atmospheric pressure, in centimetres of mercury.

In Figs. 4 and 5 we have embodied the results of the more important tests upon this experimental plant. In Fig. 4 the specific power or power per ton per hour lifted is plotted against the actual air velocity at the top of the 9 m. pipe. It will be noted therefrom that an increase of load was accompanied by a decrease of specific power. It must be remembered, however, that these horse-powers include the work done in overcoming the air friction and acceleration in the pipe. The fall of pressure due to air friction and acceleration has already been discussed —see Fig. 3 (*ante*). Assuming that the power consumed by air friction and acceleration is the same whatever the grain load, it will be seen that this power will be a greater proportion of the total power when the grain load is small than when it is large. This might have accounted for the apparently greater efficiencies at high loads shown in Fig. 4. The fall of pressure due to air friction and acceleration has therefore been determined for each experiment from Fig. 3, for the particular value of V_{a_1} holding in that experiment. This fall of pressure added to the pressure p_1 which actually obtained at the top of the pipe, gives the pressure p_1^1, which presumably would have obtained had there been no friction and acceleration losses. The horse-power per ton per hour was then calculated, using the expression $\log_e \frac{p_o}{p_1^1}$, instead of $\log_e \frac{p_o}{p_1}$. This corrected horse-power is shown in Fig. 5. It will be seen that the horse-powers for different grain loads have now been brought considerably nearer the same value. They are, however, still greater for low grain loads than for high grain loads. It is, of course, quite possible that owing to the presence of grain in the pipe, the air friction losses have greater values than those given in Fig. 3, in which case the corrected horse-powers might all have been reduced to the same value at all loads; but we have no means of estimating separately the air friction when grain is present in the pipe. A more probable explanation of the different values of horse-power per ton per hour at different loads is that the friction of the grain itself against the pipe consumes a greater proportion of the total power when the load is small than when it is large. This is dealt with Sec, (12) below.

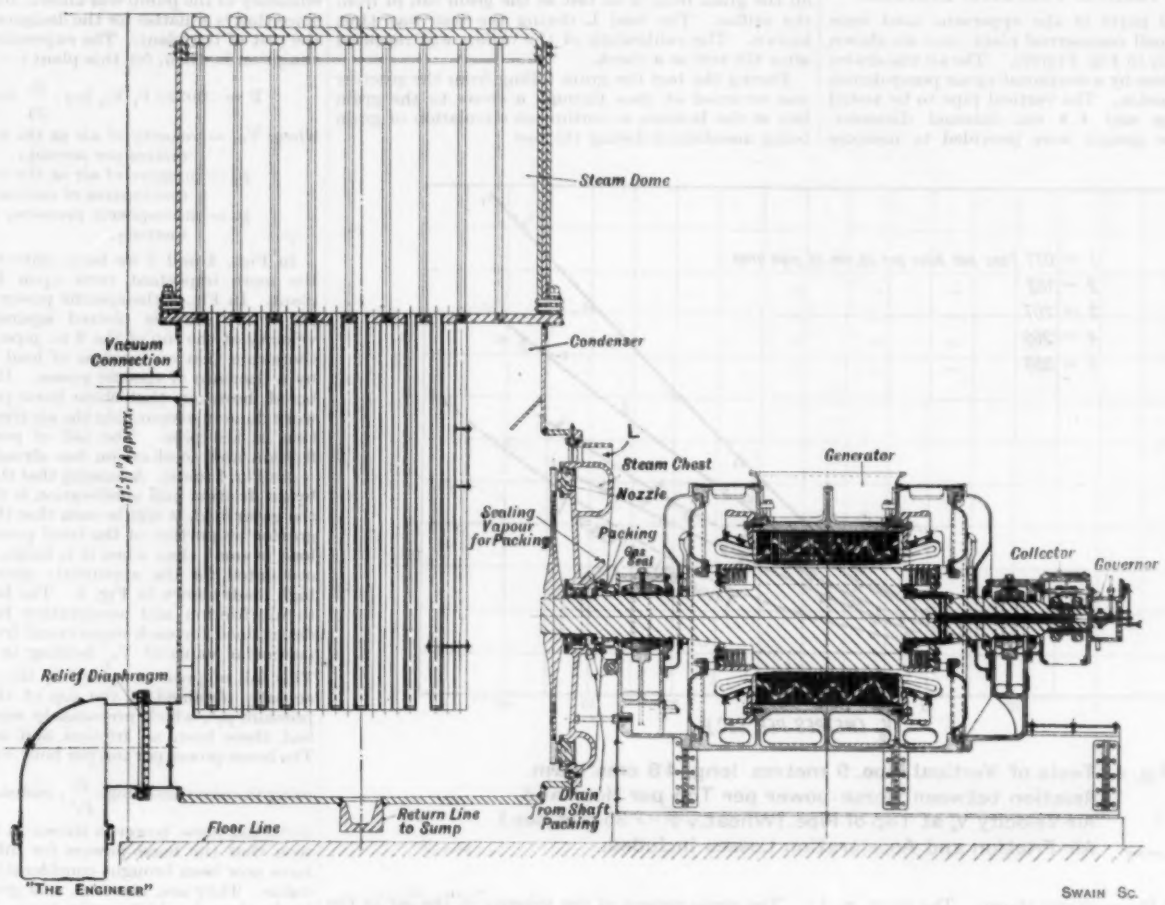
In Table II. we gave the theoretical horse-power per ton per hour for various types of acceleration in the pipe, the friction of air and grain against the pipe being neglected. We had reason to suppose that Case I. represented fairly closely the type of acceleration holding in a vertical pipe of constant diameter; and, further, we showed that the efficiency obtained in Case I. probably cannot be greatly improved upon by tapering the pipe in any manner. The theoretical powers for Case I. are shown by dotted lines in Figs. 4 and 5, and it will be seen that the results of this approximate theoretical case are quite of the same order as the actual results, especially at low velocities, when the grain and air friction are presumably small. The minimum horse-power per ton per hour for Case I. for a pipe 9 m. long was found to be .13, when the air velocity at the top of the pipe was 14 m. per second—see Table II. A comparison with Figs. 4 and 5 will show that these values correspond closely with the results of the tests.

The Emmet Mercury Vapour Plant.

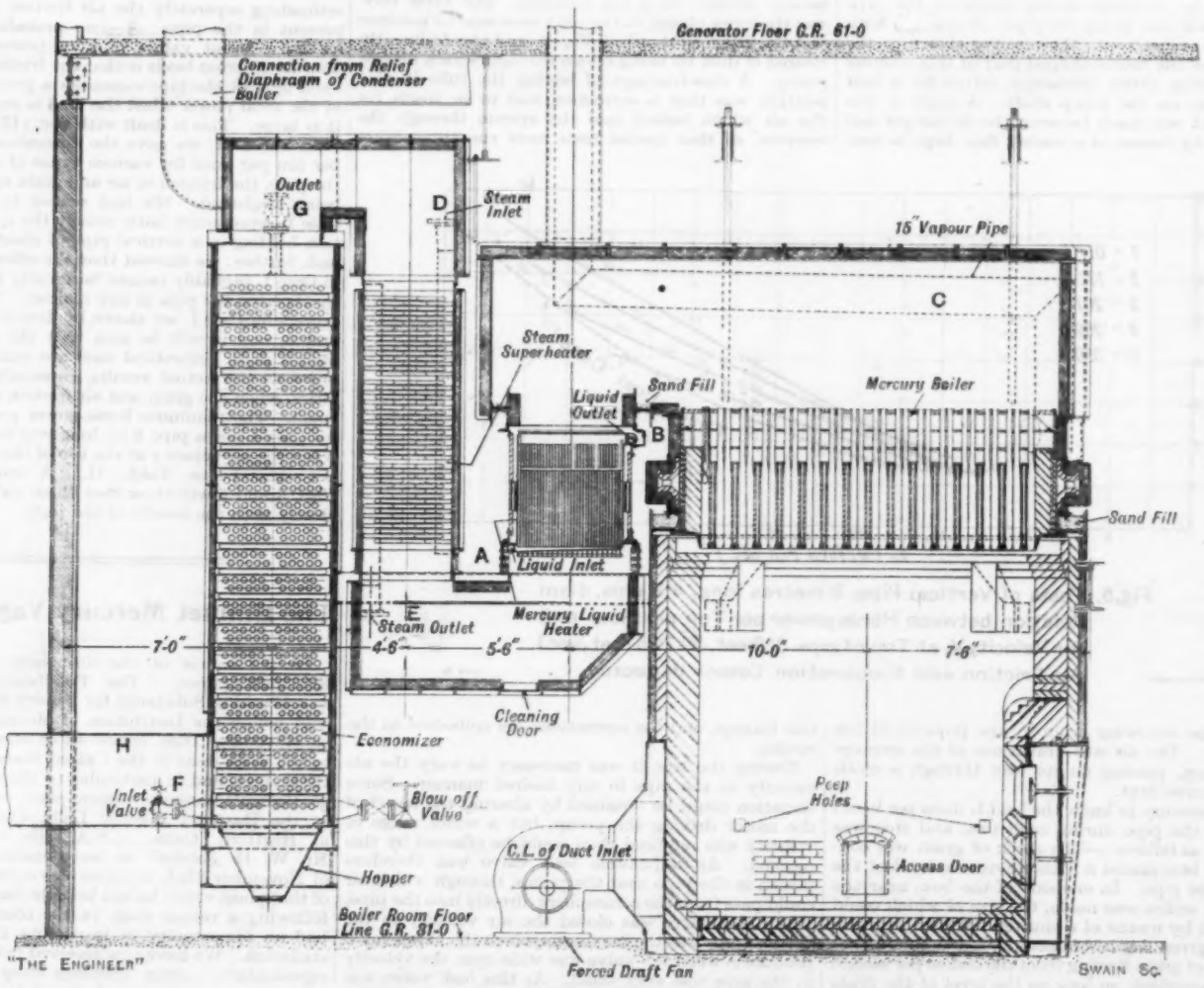
IN the course of the discussion on Mr. W. J. Kearton's paper, "The Possibilities of Mercury as a Working Substance for Binary Fluid Turbines," read before the Institution of Mechanical Engineers on November 16th, considerable attention was paid to the work done in the United States by Mr. W. L. R. Emmet, and in particular to the example of that gentleman's mercury vapour plant now in operation at the Hartford Electric Light Company's station at Hartford, Conn., U.S.A. By the courtesy of Mr. W. H. Patchell we were enabled, in our issue of November 23rd, to reproduce certain photographs of that plant which he had brought back from America following a recent visit, in the course of which he had an opportunity of inspecting the Hartford installation. We have now received from our American representative some drawings showing the general arrangement and some of the details of the plant,

MERCURY VAPOUR PLANT AT HARTFORD, CONN., U.S.A.

(For description see opposite page.)



GENERATOR, TURBINE AND CONDENSER-BOILER



MERCURY BOILER, ECONOMISERS AND SUPERHEATER

and we reproduce them herewith in the belief that they will be studied by our readers with considerable interest.

The plant, it may be recalled, consists of an oil-fired mercury boiler generating mercury vapour at 35 lb. pressure and at a temperature of about 850 deg. Fah.—800 deg. plus 50 deg. superheat—and of a mercury vapour turbine designed to develop sufficient power to drive an alternator of 1800-kilowatt capacity. The mercury vapour is exhausted from the turbine at a temperature of 432 deg. Fah., and is condensed in a vacuum of 28½in. The latent heat liberated by the condensation is taken up by the cooling water flowing through the condenser, which water, having been pre-heated in an economiser, is converted into steam at 200 lb. pressure. This steam, after being superheated by 80 deg. to 100 deg. of added temperature, is delivered into the ordinary steam supply of the station.

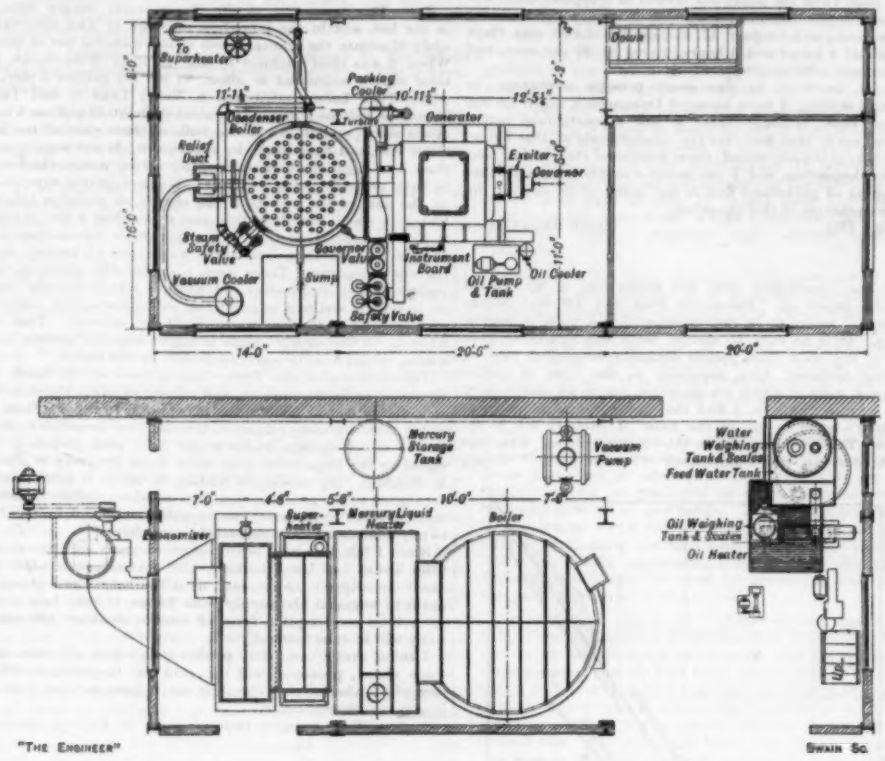
It will be gathered from the engravings given herewith that the mercury boiler plant is situated on the lower floor and directly beneath the mercury turbine and the generator. The mercury boiler consists of a short cylindrical drum suspended over the top of the furnace chamber, the junction being made gas-tight by means of a sand seal, which permits the boiler to "breathe." Through the drum pass vertical flue tubes, which are hexagonal in section over their lower portions and circular above. The tubes are fixed in the tube plate by autogenous welding, a process employed throughout to obtain the necessary high degree of gas-tightness to the mercury vapour. The liquid mercury, before entering the boiler, passes through an economiser in the furnace flue. From the mercury storage tank it flows by gravity into the heater at A and leaves at B for the boiler. From the vapour space surrounding the cylindrical portions of the flue tubes—which space is provided with baffle plates—the mercury vapour escapes by way of the pipe C to the turbine on the floor above. The flue gases leaving the mercury economiser are led through a steam superheater, the inlet of which is at D and the outlet at E, and then through a water economiser, the inlet of which is at F and the outlet at G. The gases finally escape by way of the duct H to the chimney, and from the outlet E the superheated steam is taken to the main steam supply of the station. The pipe C is led through the flue space and in passing along it the vapour is superheated.

On the floor above the mercury vapour passes into a horizontal duct furnished with a double safety valve and a double governor valve. This duct leads the vapour into the "steam" chest of the turbine. The turbine is of the single-stage impulse type, and is housed, partially at least, within the condenser-boiler, wherein, as stated, a vacuum of 28½in. is preserved. The vapour is condensed against vertical tubes containing the heated feed water derived from the water economiser on the floor below. The liquefied mercury collects in a sump at the foot of the condenser, whence it flows by gravity back to the boiler. The steam generated in the condenser collects in an overhead dome, from which it is led to the superheater in the furnace flue.

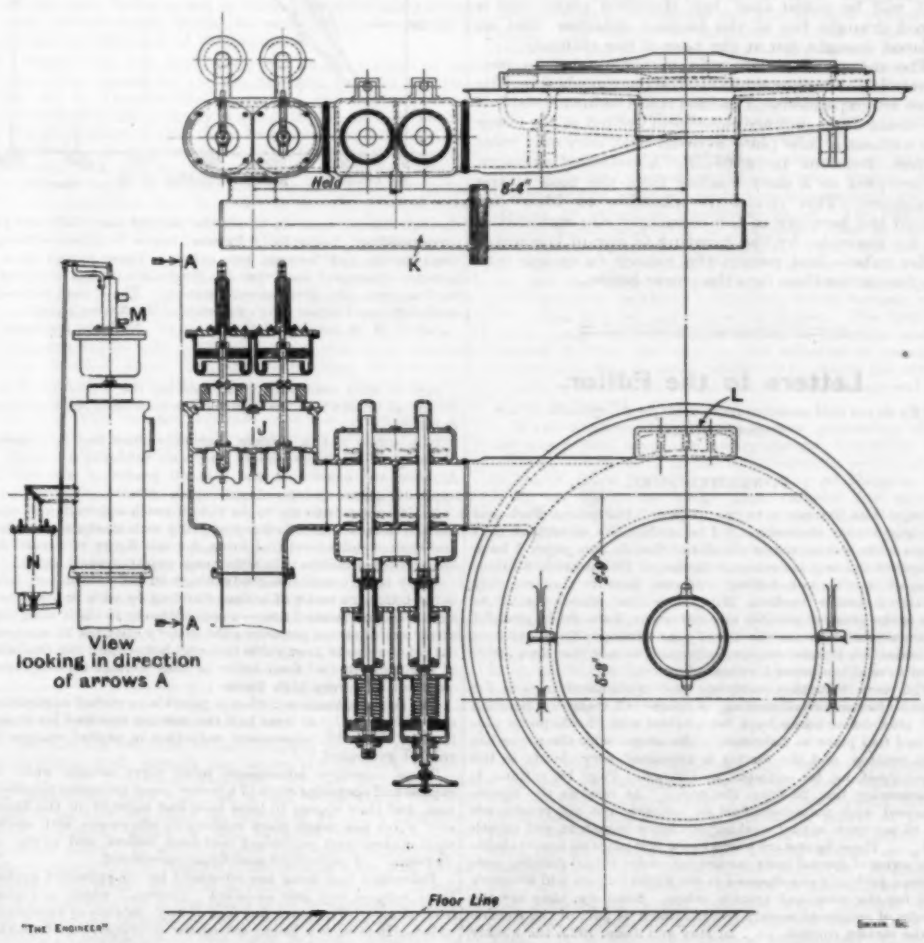
The plant embraces several interesting details in its design. The turbine blading is made of nickel steel although a certain number of tool steel blades were fitted for the purpose of test. The turbine shaft is provided with glands sealed with illuminating gas. When it is desired to shut down the plant, illuminating gas is turned into the system to prevent the ingress of air and the oxidation of the mercury that would thereby result. In view of the fact that a comparatively slight rise of pressure in the mercury vapour carries with it a considerable increase in temperature, and of the fact that under normal conditions the plant is working close up to the maximum point as regards the temperature that the metal exposed to the vapour will withstand, it is obvious that the safety valve arrangements must be delicate and certain in their action. The exact details of the construction and action of the safety valve on the main supply pipe to the turbine are not authoritatively known, but from the drawing reproduced herewith, we deduce the following:—The valve is duplicated in order to avoid a mishap through the failure of any part of it. Either valve, when it lifts, permits the discharge of mercury vapour from the main supply pipe into a chamber J, whence, flowing along the rectangular sectioned duct K, it enters the condenser by way of the ports L, and is thus led to by-pass the turbine. Each valve spindle at its upper end bears against a flexible diaphragm, above which, and in line with the valve spindle, is a second spindle carrying a piston working within a cylinder filled with pressure oil. The tail rod attached to the piston is tubular in form, and contains a piston valve in the form of a spindle. At M the inlet and outlet for the pressure oil supply to the piston-valve chamber are indicated. Movement of the piston-valve allows of a rise or fall of the oil pressure above the main piston, and, therefore, leads to the safety valve closing on its seat or rising therefrom. The piston-valve moves automatically under the action of the linkage shown, and a piston inside a vessel N open to the main supply pipe interior.

The action of the governor valve is equally uncertain, and again we can only suggest the method of working from a close study of the original drawing. The two valves are of the double-beat type. They are disposed on opposite sides of a partition completely blocking the section of the main supply pipe. To surmount this partition the vapour has to pass out through the first valve into a surrounding chamber and then through the second valve back into the main on the turbine side of the partition. The governor is of the centrifugal type, and is situated at the far end of the generator shaft. It is inferred that it acts upon the governor valves by varying the pressure of an oil supply admitted beneath the spring-loaded pistons, shown at the foot of the governor valve spindles. It would appear that these spindles are gas-sealed and that to this end they are surrounded by bellows of the aneroid type in isolated chambers lying immediately above the piston loading springs. One of the spindles is, it will be noticed, provided with a hand wheel for regulating purposes.

The unusually high temperatures of the working substance at the various stages of the cycle through which it passes require attention, not only in the choice of material used for the construction of the turbine but elsewhere. Thus, for example, a cooler has to be provided for the fluid used for packing the glands of the turbine shaft. Moreover, as already stated, the mercury vapour exhausted from the turbine, even though the vacuum in the condenser



PLANS OF GENERATOR AND BOILER ROOM FLOORS.



SAFETY AND GOVERNOR VALVES ON TURBINE MAIN.

be as high as 28½in., has still the very considerable temperature of 432 deg. Fah. A vacuum cooler has, therefore, to be provided between the condenser and the vacuum pump. This device not only lowers the temperature to which the vacuum pump is exposed, but also condenses any mercury vapour drawn over from the condenser, and prevents its discharge from the vacuum pump outlet.

The form given to the mercury boiler is another point deserving attention, for it appears to differ from that shown in the simple diagram which we published in our issue of November 23rd. We understand that the Hartford boiler represents the fifteenth design which has been constructed and tried. Some of the earlier patterns were of the mercury-tube type, and others, like the Hartford example, of the fire-tube type. The chief problems to be solved were the construction of a boiler that would not require the use of a prohibitive amount of mercury, that would not overheat, and that would be free from injurious expansion strains. In the Hartford design the circular upper ends of the fire tubes are expanded and welded into a circular tube plate. The lower hexagonal ends are welded directly together without a tube plate. The abutting hexagonal faces are not, however, quite flat but slightly curved, with the result that mercury is able to find its way between them. In the section of the boiler given herewith a "down tube" closed at the foot and open at the top is interposed between and welded up with the hexagonal portions of the fire tubes. Similar down tubes are interposed in every third row parallel with the section shown, each such row being separated by two rows containing an unbroken series of hexagonal fire tubes. This arrangement results from the assembly of the tubes in groups of seven, namely, six fire tubes arranged hexagonally round one down tube.

The Hartford plant holds about 32,000 lb. of mercury, and is designed to evaporate 230,000 lb. per hour, so that each pound of mercury is turned into vapour nearly eight times an hour. It is expected that, as a result of reducing the size of the mercury spaces in the mercury boiler and the mercury economiser, the quantity of mercury required in a fresh design could be reduced by nearly 50 per cent. It appears that the Hartford boiler suffers from the defect of being inaccessible for cleaning purposes, and that a new design is now being produced in which this trouble will be overcome by adopting the mercury-tube instead of the fire-tube principle, and by the employment of headers, which, when it is desired to clean the tubes, will be cut open and then re-welded.

It will be noted that the Hartford plant uses a forced draught fan at the furnace chamber, and an induced draught fan at the base of the chimney.

The mercury condenser is in some respects constructed in a manner similar to the mercury boiler. The tubes are expanded and welded into the lower plate of the steam dome, but are closed and welded at the lower end without a tube plate in order that they may have perfect freedom to expand. A relief diaphragm is provided in a duct leading from the foot of the condenser. This device is intended to blow out should the pressure in the condenser rise seriously—as, for example, by the bursting of one of the water boiler tubes—and permit the vapour to escape into the flue rather than into the power-house.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

POWDERED FUEL.

SIR,—With reference to my paper, "Pulverised Fuel and Efficient Steam Generation," I note that the statement continues to be industriously circulated that in this paper I have compared the regular running figures of Dalmarnock Station, Glasgow (mechanical stoking) with the short test figures only of the Lakeside Station, Milwaukee (pulverised coal). As this is the grossest possible mis-statement, I should be grateful if you would allow me the use of your correspondence columns to contradict it most emphatically, and to ask everyone interested to read the paper for themselves.

The very fact that complete and continuous records for month after month, including, of course, all stand-by, banking and blow-down losses have been taken with the Lopulco pulverised fuel plant at Lakeside, is the reason why the paper has been written, and the matter is explained very clearly in the paper itself, as, for example, as follows:—Page 18, column 1, commencing line 22 from the top. "As regards the figures obtained with pulverised fuel at Lakeside the net results are 85–86 per cent. actual working efficiency month in and month out. . . . These figures are based in the first place on a most elaborate series of special tests carried out under actual running conditions, probably unsurpassed in the world for care and accuracy and for the time and trouble taken. Secondly, they are the results of continual weekly records taken as part of the routine of the station control. . . . In May and June, 1923, the weekly figures averaged 86–87 per cent."

It is, of course, the figures for continuous running that matter, but I have also included the results of a number of days' tests at Lakeside. On one occasion—page 18, column 2 of the paper—89.1 per cent. efficiency was obtained, whilst on page 20—Table 8—I have given very elaborate figures for five tests varying from 19.92–42.33 hours duration, in which the efficiencies varied from 84.6–89.1 per cent. efficiency. During the last few days I learn 91.3 per cent. has been obtained on one test.

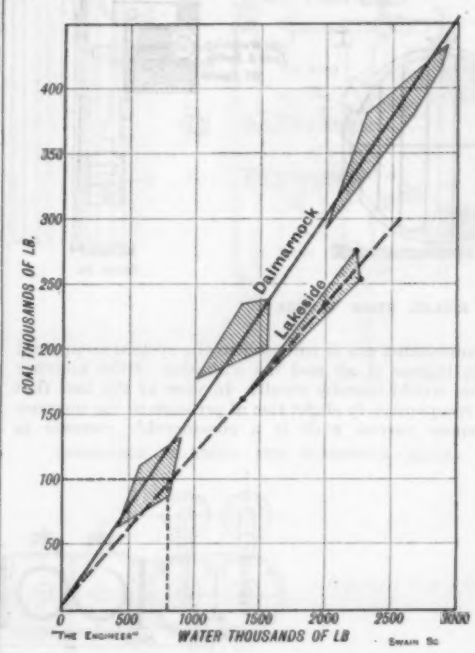
Accordingly, therefore, in the comparison I have assumed 86 per cent. for pulverised coal, the continuous figures, since in the more recent stations the guarantee figures alone are as high as 88 per cent.

As regards Dalmarnock, I give on page 16 the Dalmarnock figures for 52 consecutive weeks—1922–1923—showing 76.6 per cent. boiler plant efficiency, whilst as regards day's trials, I give on page 15 of the paper the results of a typical short test—one day, September 21st, 1923—the efficiency figures being 78.4 per cent., and on page 17, the results of two very short snap tests of 6 hours and 3 hours, giving 81.92 per cent. and 83.56 per cent. efficiency respectively.

In order, however, to give every possible advantage to mechanical stoking, I have assumed Dalmarnock might be run at 81½ per cent., although there is not a mechanical stoker station on earth that has ever run continuously at this figure. I would ask, as already stated, those interested therefore to read the paper themselves, and I can assure a number of people that the progress of pulverised fuel is not going to be delayed by misrepresentations of this character.

January 12th. DAVID BROWNLIE.

SIR,—The controversy that has arisen out of Mr. David Brownlie's paper on "Pulverised Fuel and Efficient Steam Generation," seems to be degenerating into a mass of special pleading. It is so easy to distort facts and figures to give colour to any view that justice demands scrupulous care in presenting technical data, especially in the form of curves and graphs, most of which are smoothed out to an unnecessary extent. As an example, I find that the curve accompanying Mr. Napier's letter to you in the issue of January 4th is inaccurate. The conclusion drawn from it is worthless. I enclose a graph showing the Dalmarnock "Parson curve" drawn



through shaded areas in which the plotted data fall, and the corresponding Lakeside "Parson curve" drawn through three points and between two others. These curves have a common origin and show that Mr. Brownlie's data is as accurate as that from the Dalmarnock station. The dotted rectangle in the left-hand corner shows the scale of Mr. Napier's graph.

Acton, W. 3, January 14th. NORMAN SWINDIN.

SIR,—I have read with great interest the discussion in our Technical Press which has followed the reading of Mr. Brownlie's paper.

It is surely not in dispute that pulverised fuel as a means of firing power-house boilers has been rendered a success in America and elsewhere, and that all grades of coal can be applied with many advantages in this manner.

It also appears to me to be not so much a question of comparison between the efficiency of firing with mechanical stokers and that of pulverised fuel firing, for this figure at normal full load rating of boilers is in either case approximately equal.

What is of outstanding advantage in pulverised fuel firing is the collective result of boilers standing by with fire chambers closed and no banked fires—a real economy in itself with little or no loss of steam pressure; the facility afforded to use small coal of equivalent heat value to larger lump coal; the flexibility of a pulverised fuel fired boiler to take normal load or forced overload to a very high figure.

The latter advantage makes it possible to curtail expenditure on boiler plant by at least half the amount required for stoker-fired boilers, with consequent reduction in capital charges for current generated.

These collective advantages must carry weight when the capital and operating costs of a power plant are under consideration, and they appear to have been lost sight of in the discussion which has taken place relative to efficiencies with mechanical stokers and pulverised coal-fired boilers, and to the one "system" of pulverised coal-firing mentioned.

Pulverised fuel firing has advanced for all approved applications beyond any one so-called "system," which is entirely a misnomer. There are but few, if any, patents of exceptional value. It is now a broad art in the development of which a very wide choice of plant has become available, and it is only a matter of accepting the proved results of both plant items and of the recognised effective applications of pulverised fuel to see whether this method of using solid fuel outbids any other method for any one particular purpose.

The use of fuel in pulverised form has added another efficient means of applying coal to best advantage under prescribed and suitable conditions. One such purpose which has won for itself undoubted success is that of its application to large power-house boilers in view of the above advantages, the relative small volume of flue gases and the absence of smoke.

LEONARD HARVEY.

London, S.W. 1, January 10th.

BOMBAY WATER SUPPLY.

SIR,—The extensions of the Tansa water supply detailed in the last and in the preceding numbers of THE ENGINEER, aptly illustrate the immense cost of the wasteful use of water. When I was chief engineer to the Bombay Waterworks, the total supply amounted to about 31 million gallons a day, to which Tulsi Lake contributed 4, Vehar Lake 7, and Tansa 20 million gallons a day. This yielded about 30 gallons a head of the then population; as the bulk of these were of the Kuli class, who, as I have found by experiment, do not require more than 5 or 6 gallons a head for their actual wants, this ought to have proved an ample supply. Without proper supervision on the part of the owners of the chawls, or common lodging-houses in which they live, this class never close a tap or repair it if it is broken, so that under favourable circumstances as regards supply, they frequently waste ten to twenty times the above amount. There were, consequently, constant complaints of lack of pressure, on which I was frequently called on to report, and had to point out, *ad nauseum*, that adequate pressure and unchecked waste could not co-exist. That any addition to the supply, while it might improve matters for a season, would soon be again overtaken by the waste.

The members of the Town Council were all, or nearly all, interested in house property, and refused to admit the existence of waste on it, but preferred to attribute it to leakage from the mains, and resolutely refused to accede to my proposals to introduce a meter system, which would have been peculiarly well suited to the large units into which house property is divided in Bombay. My reason for wishing to adopt it being usually attributed to the generous commissions which makers of meters, and all other appliances, are popularly supposed in the East to pay officials who recommend their purchase.

Since I left Bombay, nearly nineteen years ago, the supply from Tansa has been doubled, and evidently the waste has again outstripped the increase, as it has been found necessary again to augment the supply from Tansa, at very heavy cost, till a total consumption from all sources of about 100 gallons a day will soon be reached.

I think that I can safely predict that waste will soon again forge ahead, pressures will fall, and the Corporation will be compelled, whether they like it or not, to have recourse to meters in order to prevent waste.

Ealing, W. 5, January 14th. A. FAIRLIE BRUCE

MENAI SUSPENSION BRIDGE.

SIR,—Investigations carried out by engineers on behalf of the Ministry of Transport, as would be expected, have resulted in the old Menai Suspension Bridge—the building of which was commenced by Telford in 1820 and finished in 1825—being found inadequate for the needs of the present day. It is, I believe, proposed to reinforce the present suspended span by means of a concrete arch so that the bridge will no longer be one of the suspension type; and, further, if this project is carried out, the bridge can no longer be looked upon as a monument of Telford's engineering skill, as its individuality will be, in my opinion, entirely spoilt. It is to this consideration, Sir, that I would ask your attention. I, for one, consider the proposed modification to this ancient and memorable monument to the genius of one of our most eminent civil engineers, Thomas Telford, little short of an act of sacrilege, and humbly protest at such a course being taken.

Menai Bridge is, I think, one of the first—if not actually *the* first—suspension bridge of such proportions to be erected in the world, and as such, and in the memory of Telford, should be allowed to remain as it is in its present form. It is, I think, well able to take care of ordinary light traffic, and for modern requirements why not build an entirely new structure in proximity to the existing bridge? I do not think that there would be any great difficulty in adopting this course which, in my opinion, should be taken, and I cannot but think that the engineers of this country and many others interested in the preservation of national antiquities will think in this way when their attention is drawn to the subject. I hardly think that engineers and the public generally fully appreciate what is contemplated, and when they do I imagine the opinions I have expressed will find other and stronger support.

In conclusion, may I express the hope that you will help by all means in your power to assist in preserving this memorable example of British engineering skill. Telford's model as exemplified in the Menai Bridge has proved to be the prototype of those wonderful bridges by Brunel over the Severn at Clifton, and by Roebling in the United States, of which, that spanning the East River between New York and Brooklyn is the most notable, and should, therefore, most certainly be preserved. E. CECIL POULTNEY.

Llandudno, January 15th.

Obituary.

ARTHUR JOHN HOBSON.

THE news of the death of Mr. Arthur John Hobson at Hong Kong on January 12th will be received with great regret by his many friends in the Admiralty Service and the Navy. Mr. Hobson entered Portsmouth Dockyard as an apprentice in 1882, and although he did not succeed in entering the Royal Naval College, Greenwich, he made good progress, and very quickly rose, through the ranks of draughtsman and foreman, to be an assistant constructor in 1901. After some service in Devonport and Sheerness Dockyards, and as overseer of H.M.S. Cobra, he was called to the Admiralty, where he remained until November, 1922. During this period he contributed materially to the development of the modern destroyer and the light cruiser. He had a responsible share in the production of over 300 of these vessels, aggregating at least 450,000 tons displacement and 5,000,000 horse-power.

Mr. Hobson was made constructor in 1912 and acting chief constructor in 1917, and accepted an appointment as acting chief constructor at Hong Kong in November, 1922.

Railway Matters.

PULVERISED coal is being adopted on some of the locomotives of the Japanese railways.

EXPERIMENTS on the use of pulverised coal for locomotive firing are being made by the Railway Commissioners of Australia.

IT is proposed to electrify the sidings of the South Manchuria Railway at the Dairen wharves. The scheme involves 45 miles of track.

THE cost of living index figure having risen from 69, when the adjustment was made last July, to 77, and, therefore, by more than 5 points, the railwaymen are receiving 1s. per week more from January 1st.

IT is claimed—but we fail to see the point—that were the railways in the Irish Free State amalgamated into one, Belfast would be placed in a position of advantage over Dublin. This, at least, was the view expressed recently at the Dublin Ports and Docks Board. The same meeting drew attention to the proposed service between Holyhead and Belfast, which it was thought would divert a considerable amount of cattle traffic from Dublin.

A COLLISION occurred at King's Cross Station—London and North-Eastern Railway—on the 1st inst., which, it is officially stated, was a consequence of the red glass in a signal having been broken by a carriage door, with the result that the light appeared white. White lights are never now used on railways for all-right signals, and it was not the white light but the absence of a red that caused the accident. The signal, by the way, must have been within the structure gauge to be caught by a carriage door.

THE de-control of British railways was preceded by the Railways Act, 1921, in which was authority to pay them sixty million pounds in settlement of all claims they had on the Government. The control of the United States railways ceased on March 1st, 1920, and their releasing Act provided for the setting up of an authority to investigate, decide and settle their claims. This work has just been completed—nearly four years after the end of control—and has necessitated the payment of 1696 million dollars.

IT is reported that the directors of the London, Midland and Scottish Railway Company have decided to reopen the Buckie-Keith Railway as soon as possible. This decision, which has given widespread satisfaction, has been urged now for several years. The line is 13 miles long, and was lifted during the war and relaid in the Highlands for naval service. There will be a good deal of repair work necessary to embankments and bridges before the railway can be re-opened, in addition to the relaying of the rails, and this should provide work for the unemployed in the district. The re-opening of this line is expected greatly to stimulate trade in the immediate neighbourhood.

THE Commission of Swedish and Norwegian experts which has been engaged in the study of the question of a new railway connecting Sweden and Norway has presented its report, in the course of which it states that such a line is desirable, especially from the Norwegian point of view. The Commission considered two alternative proposals, between which the opinion of the members was divided. The new railway will shorten the journey from Gothenburg to Christiania by from 24 km. to 28 km. The cost of the railway will be higher for Sweden than for Norway and the advantages less, but the Commission is unanimously of the opinion that the interests of international communications must take precedence of all others.

THE value of some of the blessings we enjoy has often to be brought home by their being taken away from us. A delay to a train on the Underground causes congestion on the platforms and crowding in the trains when they resume running. Passengers thus may learn how much superior is the train service of to-day than when, for instance, steam trains ran on the Metropolitan and Metropolitan District. A very annoying dislocation of the automatic signalling on the Metropolitan Railway on Thursday of last week was useful in showing how greatly superior are the transit facilities with automatic signals every few hundred yards to the arrangements under which only one train at a time was practicable between the stations.

THE working of facing points by power permits them, under the Ministry of Transport Requirements as to New Railways, to be, like trailing points, any distance from the signal-box. Herein lies the opportunity for many economies. Power plants are, however, expensive. What is now being done is to operate the facing points alone by power, using low-voltage point machines. This was, for instance, done at Ashington, as described in THE ENGINEER of May 19th, 1922, and at Quainton-road—our issue of September 1st, 1922. Now, low-voltage machines have been put down at three places on the Great Western where facing points are 1920ft., 1700ft. and 1200ft. respectively from the signal-box, and in each case a signal-box was dispensed with. The fact that until February, 1900, the limit allowed for facing points by the Board of Trade was 600ft. shows what perfection has been reached in signalling.

THE railway between Thies and Kayes, linking up Dakar, in Senegal, with the fertile hinterland of the Niger, was recently opened by M. Carde, Governor-General of French Western Africa, and M. Touzet, Chef du Cabinet of M. Sarraut, Minister of Colonies. This new section of line is 414 miles long, and it joins the section from Kayes to Bamako and Koulikorom, on the Niger, which is 390 miles long, thus providing Western Africa with an almost straight line of rail 800 miles long, not including the two branches from Thies to Dakar and St. Louis respectively. The gauge is 1 m., and the ballasting is sufficiently heavy to permit of a speed of 45 miles an hour. A bridge over 250 yards long spans the Falame River below Kayes. Before the construction of the new line, communication between the coast and the interior was largely by the Senegal River; but that was a circuitous route, as well as being uncertain owing to rapids. It is hoped that the new railway will enable the cultivation of cotton to be more actively pursued in the French Sudan.

Notes and Memoranda.

THE *Nugget* reports that the mines of the Sudbury, Canada, district are now producing nickel and copper to the value of about 25,000,000 dollars a year.

EXPERIMENTS on Natal coal carried out in South Africa by Mr. P. N. Lategan show yields of coke varying from 14.8 cwt. to 16.6 cwt. per ton of coal; 10.3 to 15.7 gallons of tar; 11.5 to 22.4 gallons of ammonia liquor; and 1980 to 2930 cubic feet of gas.

ESTIMATES of the amount of available water power in New Zealand show a total of 4,076,700 horse-power, of which 759,700 horse-power is in North and 4,317,000 in South Island. In the distribution of power resources, South Island is in an advantageous position, as the bulk of its potential supply is found near the deep-water sounds of the west coast, where there are many sites suitable for electro-chemical and electro-metallurgical industries.

IT is reported from America that compressed fibre has been used successfully as a material for the pistons of internal combustion engines. The fibre, which is said to be somewhat like Bakelite, is heated and moulded between dies, and a flat disc-head of a hard stone-like material is incorporated. This insulates the piston from the injurious effects of heat. It is stated that pistons of this type have successfully withstood road tests aggregating 10,000 miles without trouble.

THE data obtained in recent research work by the American Bureau of Mines show that the analysis of the gases dissolved in underground waters may be used by the prospector or geologist as an additional aid in discovering new oil or gas fields. The hydrocarbons present in the water serve to indicate whether oil or gas sands exist in the region through which the waters have passed. A portable field apparatus has been developed by the Bureau, which can be used for removing and analysing the gases dissolved in the waters.

IN reading a paper on "Water-cooled Aero-engines," before the Institution of Automobile Engineers, Mr. A. J. Rowledge said it could be claimed that all the great performances in the air had been accomplished by machines fitted with water-cooled engines. Furthermore, one might expect that it would always be possible to build a faster machine with a water-cooled engine than with an air-cooled one. On a weight basis, the water-cooled engine was almost as good as the air-cooled, while on a power and reliability basis it scored over the air-cooled engine.

DISCUSSING the use of liquid oxygen as an explosive for the gold mines of the Rand, Mr. T. G. Colquhoun said that it would hardly be applicable in the stopes, where perhaps fifty to sixty shots are fired in each stope, unless the system of blasting is altered, but that it could be used in the development drives, winzes and raises. With regard to the time required for charging, it is, says Mr. Colquhoun, quite an easy matter for the miner and his assistant to charge eight holes in ten or eleven minutes, and, if fired with electric fuses, would be well within the period of maximum efficiency of the explosive.

WRITING to the *Daily Telegraph* on the subject of lead poisoning, caused by the use of white lead for painting, Dr. W. R. Douglas Shaw says that the consumption of white lead in this country is about 50,000 tons per annum. The production of zinc oxide has, however, increased considerably. It is now stated to be over 16,000 tons per annum, and one English company which has recently installed works in Wales, and acquired land for further works, estimates that it could ultimately produce more than twice enough zinc oxide to offset the decreased production of lead if the Geneva Convention is ratified.

LEAD and zinc production in the United States increased last year—the latter by approximately one-third—compared with the 1922 output. Figures made public on January 2nd placed the total mine production of all kinds of lead in 1923 at 534,000 short tons, as compared with 476,849 in 1922. The refining output from domestic ores totalled about 550,000 short tons, as compared with the 468,746 in the preceding year. The recoverable zinc content of the ores, which amounted to 472,184 tons in 1922, reached 623,000 tons last year, while the output of primary metallic zinc from domestic ores in 1923 totalled 485,000 tons, as compared with 354,277 in 1922.

ACCORDING to Mr. G. S. Hume, of the Geological Survey of Canada, the oil well at Wainwright will perhaps lead to further exploration along the terrace structure. The oil at Wainwright is of a heavy quality, analysis showing it to contain but 2¼ per cent. of light spirit. While further favourable structures for accumulation of oil probably exist in this area, they will necessarily be of limited extent, and only the wells drilled on such structures can hope for success. In other words, the producing wells in this, as in other areas, are localised. Owing to the heavy mantle of drift which covers the rocks over large areas in this district, structures are not easily studied, so that it seems probable much test drilling will be necessary before the producing areas can be determined.

ALUMINIUM paint is easier to apply and cheaper than aluminium leaf, though the latter is preferred, according to the *Structural Engineer*, for the highest grade of decorative work, because it has more body. If the leaf is used, it can often be improved by being lacquered and polished, which is not required with well-mixed powder paint. It would appear that there is nothing to show superiority in the 300 mesh powder over that sifted on the 200 mesh, so far as covering power and brilliance are concerned, but if the paint is to be applied by means of a spraying apparatus, then the finer powder is to be chosen in preference, as less likely to clog. Polished and unpolished metal yields equal brilliance in finish. There is some evidence that the stearic acid present in the polishing medium improves the durability of the paint, but probably not to a sufficient degree to compensate for the enhanced price. As regards mediums, raw linseed oil gave excellent results both for covering properties and durability. The drawback to its use is the very slow drying process, the powder acting as a retarding agent.

Miscellanea.

THE trunk telephone line between Bombay and Delhi has been completed.

THE traffic through the Panama Canal during the year 1922–1923 amounted to 18,605,786 tons.

A NEW factory for the manufacture of bolts and rivets is being put up at Richmond, Victoria. The works will employ about 200 hands.

SOME promising deposits of silver-lead ores are said to have been discovered in the north-eastern part of Australia, from 70 to 80 miles from the coast.

IT is proposed that the Engineering Conference which is to be held in Brisbane, Australia, this year, should take place between Tuesday, March 4th, and Friday, March 7th inclusive.

A PORTLAND cement factory is being built at Popcum, some 70 miles east of Vancouver, at a cost of about half a million dollars. A local deposit of high-grade marl is to be used as raw material.

SOME Welsh colliery owners have arranged to put up a coal breaking plant in Montreal for crushing anthracite to sizes suitable for the Canadian trade. It is suggested that the minimum output will be 100,000 tons a year.

THE scheme of the Corporation of Calcutta for the extension of the Pulta Water Works, which was sanctioned last May and will involve the expenditure of Rs. 8,46,300, has been extended to include six further filters and a larger settling tank.

THE extensive scheme for water storage which has been embarked upon by the Victorian State Rivers and Water Supply Commission, will necessitate the expenditure of somewhere about one and three-quarters of a million sterling during the year.

WHEN the electrification of the Newcastle, New South Wales, tramway system has been completed, the capital expenditure involved will amount to about £1,000,000, but the change from steam traction will probably result in a reduction of working costs by 50 per cent.

AN extensive scheme of road-bridge building has been embarked upon by the Birmingham Corporation, with the idea of increasing the capacity of some of the principal roads. The new Salford Bridge alone, work on which is to be started immediately, will cost approximately £100,000.

SINCE the Wallaroo and Moonta mines have been closed down, the Mount Lyell and Mount Morgan mines are, says the *Industrial Australian*, the only active properties from which copper is being won on a large scale in Australia. The high cost of labour and supplies is put down as the cause of this stagnation.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in December amounted to 626,900 tons, compared with 598,200 tons in November and 533,700 tons in December, 1922. The number of furnaces in blast at the end of December was 204, an increase of five during the month. The production included 201,600 tons of hematite, 205,800 tons of basic, 153,100 tons of foundry and 33,700 tons of forge pig iron. The output of steel ingots and castings fell, owing to the Christmas holidays, from 749,500 tons in November to 653,300 tons in December.

WE understand, says *Indian Engineering*, that the report of the Director of Public Works, Ceylon, on the hydro-electric scheme, is before Government and will shortly be issued as a sessional paper. The report embodies a careful survey of the power that is available in different parts of the island, the chief locality being Aberdeen and Laxapana Falls. The cost of the scheme as now modified will be from ten and three-quarter million rupees to thirty million rupees at various stages. The work will be undertaken in stages. The first part, when complete, will deliver power to Colombo and distribute it from the city to the suburbs at reasonable distances from the heart of the city. Once the demand is known further extension will be undertaken and more power harnessed.

WHAT is claimed to be the largest generating unit in the world was, says our contemporary, *Canadian Engineering*, put to work in the hydro-electric central station of the Niagara Falls Power Company at Niagara Falls, N.Y., on December 18th. Last summer the company completed construction of a power tunnel one mile long and 33ft. in diameter, which feeds from the upper river to a basin, which in turn feeds water into three new penstocks, each 25ft. in diameter, and a steel and concrete line. The tunnel pierces the sides of the cliff on the American side at an angle of 45 deg. to the foot of the bank, and there connects with three new generating units which are being installed as an addition to the Niagara Power Company's power-house. Each unit is to be 70,000 horse-power, so that the three together will constitute an additional development of over 200,000 horse-power. The unit which has been placed in operation is the first of three to be completed. The other two are now being built.

THE Canadian Government has under consideration a project, submitted by Sir Adam Beck, Chairman of the Ontario Hydro-electric Power Commission, for the development and control of the water power of the St. Lawrence River. The proposal involves the construction, with the co-operation of the United States, of a dam control works and development plant, at Morrisburg, Ont., at a cost of from 75,000,000 to 80,000,000 dollars. The installation would produce some 350,000 horse-power for Ontario and a like amount for the State of New York. It is suggested that approximately 15,000,000 dollars, of the total of 40,000,000 dollars, which would be Ontario's share of the cost, should be borne by the Federal Government in compensation for the provision of water control facilities by the province. It is proposed to connect this system by a high-voltage transmission line with the Niagara Falls system, so that power transmitted to Toronto can release a large amount of Niagara power for the use of other municipalities in Western Ontario.

NEW SWITCHGEAR AT THE NEASDEN POWER STATION—METROPOLITAN RAILWAY

THE GENERAL ELECTRIC COMPANY, LIMITED. WITTON, BIRMINGHAM, ENGINEERS

(*For description see page 74*)

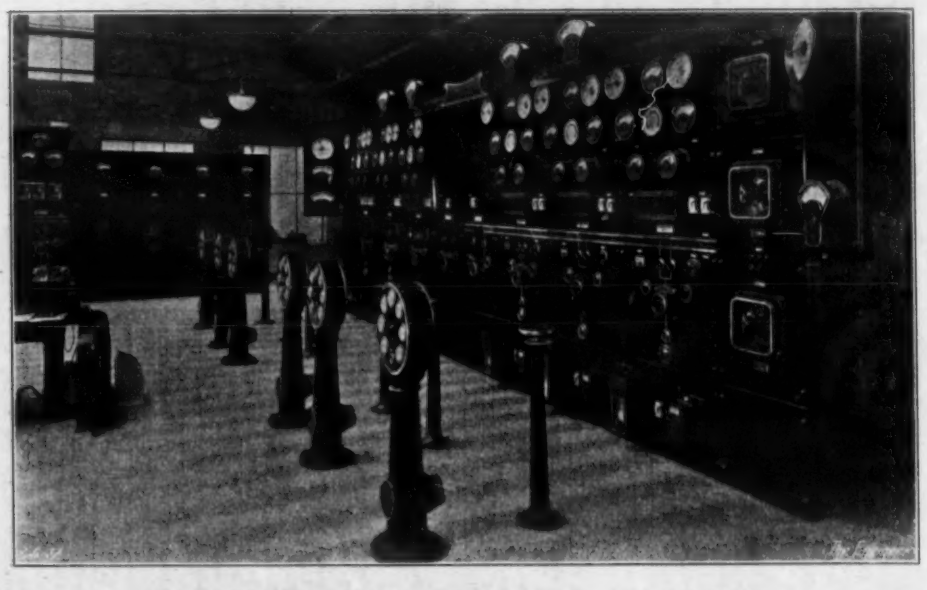


FIG. 1—GENERATOR CONTROL BOARD WITH ENGINE ROOM TELEGRAPHS

FIG. 2—FRONT OF FEEDER CONTROL BOARD

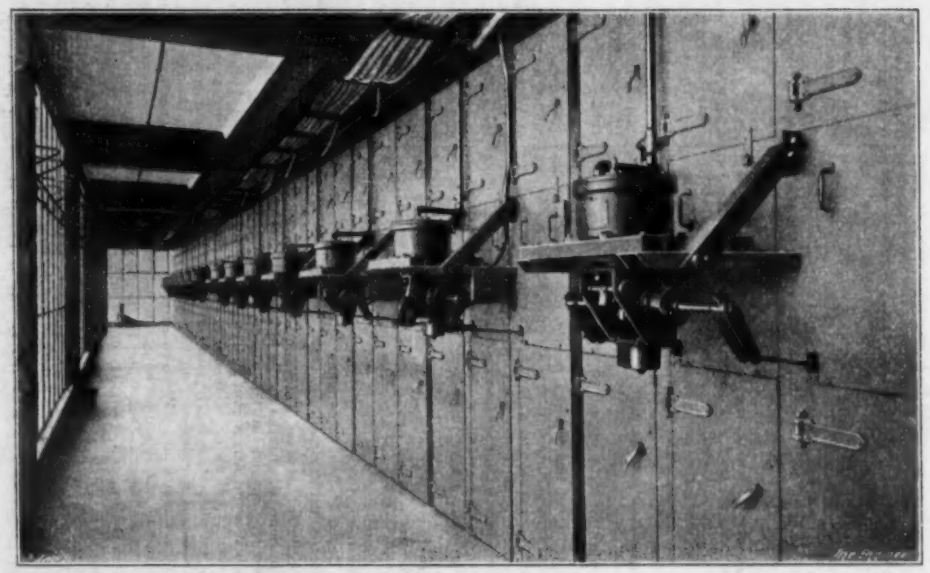


FIG. 3—FRONT OF OIL-SWITCH CUBICLES SHOWING SOLENOIDS FOR OPERATION

FIG. 4—440-VOLT STEEL-PLATE CUBICLE BOARD

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*** *With this week's number are issued as Supplements a Two-page Plate illustrating the Turbines at the Raanaasfoss Hydro-electric Power Station, Norway, and the Index to Vol. CXXXVI. Every number as issued by the Publisher contains copies of these Supplements, and Subscribers are requested to notify the fact should they not receive them.*

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SUPPLEMENTS—THE TURBINES AT THE RAANAASFOSS HYDRO-ELECTRIC POWER STATION, NORWAY, AND THE INDEX TO VOL. CXXXVI.

THE ENGINEER

JANUARY 18, 1924.

Railway Electrification.

SINCE we last wrote on railway electrification, a few weeks ago, two more meetings have been devoted to this subject at the Institution of Electrical Engineers. On January 3rd Dr. S. P. Smith delivered a lecture on "Railway Electrification in Foreign Countries," whilst on the 10th of the month there was another discussion on Monsieur Bachellery's paper on "The Electrification of the Midi Railway." As far as papers, discussions and lectures are concerned, this country is by no means behind others, yet there is no very marked inclination on the part of the railway companies to set to work and electrify long stretches of main lines. This is not surprising, for, on the whole, those who talk and write about the matter confine themselves to technical details which are of little interest to railway directors, who desire to know more about the financial side of the subject, and the best and cheapest method of setting about the job. The conflicting opinions of experts must puzzle railway men more than enough and cause them, we fear, to give up all hope of ever being able to decide what they really ought to do. In his lecture Dr. Smith showed that a very large amount of railway electrification work is being carried out in different parts of the world, and that some countries—including Switzerland, Germany, Austria, Hungary, Bavaria, Italy and Scandinavia—are using alternating current. At the next meeting, however, at which Monsieur Bachellery's paper was discussed, Mr. J. Sayers discredited the single-phase system on the grounds of telephone interference, but made no attempt to explain how it is that this system has made such rapid headway. Telephone interference on the original single-phase lines of the Midi Railway was overcome, and it was not the main reason for the final adoption of direct current, as Mr. Sayers seems to suppose. What really matters is the total cost of the scheme adopted and the efficiency of operation, not individual items, such as the task of overcoming telephone interference.

In our opinion, there is no reason to deplore the slow progress in this country. In fact, it is our belief that unless a cheaper and more simple system can be employed than that proposed, railway directors would be well advised to let long-distance main line work alone. The best policy that British business men and engineers can adopt is to endeavour to persuade all other countries to electrify their main lines, and then endeavour to secure as much of the work as possible. Meantime, the question of electrifying main lines in this country might be carefully looked into and all possible new developments should be taken into account. Unfortunately, there are electrical engineers in this country who seem to be quite incapable of realising that electrical engineering has not as yet reached a state of finality, and the mere suggestion of departing from orthodox practice seems to alarm them. In our previous article on this subject we suggested that the possibilities of the split-phase system might be considered, whereupon Mr. J. Sayers wrote a letter to THE ENGINEER stating that it would be quite impossible to use the three phases of a three-phase system separately. To what extent the system would be applicable to the main lines of this country, we do not profess to know, for it is a matter for investigation, and all we said was that the scheme might be considered. Mr. Sayers seems to be under the impression, however, that the phases could not be used separately on any railway—an assumption which is incorrect. As a matter of fact, the scheme was employed on the Rotterdam–Scheveningen Railway. The three-phase current from the generators was converted into two-phase current by means of Scott connected transformers, and the two phases were used separately on different parts of the railway. A similar scheme has been worked out for a railway in this country on which the out of balance is not expected to exceed the permissible amount, and, as Dr. Smith has explained, the Hungarian railway authorities propose to use the three phases of the general suppy system separately on their electrified lines. Moreover, if Mr. Sayers will refer to the Jubilee issue of the *Electrical Review*, he will see that Sir Philip Dawson mentions the possibility of working locomotives with 50-cycle, single-phase current, which presumably would be drawn from the general three-phase supply. It is well known that on a poly-phase system all rotating machinery tends to balance the voltage, and the proposal to use the phases separately is not by any means a new idea. There should be no great difficulty in obtaining a reasonable balance if the system is at all extensive; in any case, schemes for equalising the voltage have been proposed.

Nearly all the papers and discussions on railway electrification in these days ignore the important question of whether we are going to follow the example set by France or seek a more economical scheme. It would be a good plan, we think, if the Institution of Electrical Engineers could arrange for someone to present the complete case for alternating current on a given stretch of main line, and for someone else to deal with a precisely similar direct-current scheme. Matters such as the relative efficiencies of rotary converters and mercury vapour rectifiers, telephone interference, and so forth, are quite interesting, but discussions on these points do not enable the railway companies definitely to decide the course they should pursue. Some remarks made by Major A. M. Taylor at a meeting in 1922, however, were far more to the point. The paper was on rotary converters for 1500-volt direct-current railways, and Major Taylor endeavoured to show that, by adopting a very much higher pressure on a main line section between London and Birmingham, there would be a very considerable saving in sub-station equipment. "On such a section," he said, "there are at present some 15 passenger trains each way in a day of 12 hours. This gives a time headway of 0.8 hour per train, which at an average speed of 45 miles per hour, would give an actual space headway of 36 miles between any two trains. The line being 110 miles long is thus divided up into approximately three sections, on each of which there are two trains moving in opposite directions. The natural and proper spacing for the sub-stations on such a line would be 36 miles, but at 1500 volts this would be quite impossible; in fact, to utilise the feeder copper from the sub-stations to the best advantage, the radius of feed on either side of the sub-stations should not exceed 3 miles, which means that each sub-station would have to be restricted to a feeding length of line represented by 6 miles, and even then the average loss in the feeders would be of the order of 10 per cent. Assuming, therefore, that each locomotive takes 1000 kilowatts, we arrive at the following conclusions. The total energy required for the whole line is only 6000 kilowatts, but we have to put in 18 rotary converter equipments, each of 2000 kilowatts, or a total of 36,000 kilowatts, or six times the generator capacity, and under the best conditions at any moment we may have only three of these sub-stations in full operation and the other fifteen idle. The efficiency of rotary converters under such conditions would be extremely low, but if we employ single-phase locomotives, and assuming that we could operate at 11,000 volts, we could

put in 3 static transformer sub-stations each to supply 36 miles of track, and each of only 2000 kilowatts capacity, or a total sub-station capacity of 6000 kilowatts. The cost of a static transformer is roughly one-sixth that of a rotary converter with its transformer, and, as with direct-current six times the total generator capacity is required, it means that we shall be paying 36 times the price in the case of the rotary converter scheme that we shall be paying in the other instance, the cost of the distributing feeders being about equal in the two cases. I was told by a prominent company, which makes single-phase locomotives, that the difference in efficiency between the single-phase engine and the direct-current engine at full speed on the level is only 2 per cent., and I would, therefore, strongly recommend that we should not consider the question of main line direct-current electrification solved until we can at least distribute at 3000 volts and preferably 6000 volts, or alternatively that we should give a reasonable hearing to the single-phase proposals."

Here we have a bold and definite opinion concerning the relative merits, so far as distribution is concerned, of two systems on a given length of line, and although there are other matters to be considered, the conclusions arrived at provide a good basis for a discussion, to which many direct-current engineers would probably like to contribute. To arrive at definite ideas about railway electrification, it is essential to take everything into account, and nothing is to be gained by repeatedly referring to one particular drawback of one particular system, such as induction troubles, which can be overcome. We fully believe that it will be generally recognised in due course that a more simple scheme than the 1500-volt direct-current system is desirable for long distance main line work, and that British engineers will not follow the example set by France. The fact that after a long experience with a 3000-volt system the Italians are now endeavouring to use 10,000 volts is a pretty clear indication that the question of adopting a really high pressure is a matter worthy of consideration.

Chromium.

IF labels were not, by this time, somewhat trite, one might be tempted to speak of the present as the era or age of alloys, as compared with the "age of steel," from which we have by no means emerged. It is, however, a notable feature of recent metallurgical advances that they mainly take the form of utilising, frequently in the form of alloys, the properties of some metal or element which a few years ago was practically unknown in the metallic state outside the collections of specimens in chemical laboratories. The case of tungsten is, of course, well known, although in connection with that metal it may prove that we are still far from the maximum development. Other cases come readily to mind, such as cadmium and magnesium, and recently we have begun to hear of glucinum or beryllium. The metal chromium, however, is of more immediate practical importance. As an alloying element in nickel-chrome steels, in tungsten-chromium high-speed steels, and in such alloys as "Nichrome," we are sufficiently familiar with it—at any rate, with its name. In the nickel-chrome steels it confers the valuable property that the transformations which normally occur during slow cooling can be readily inhibited by slightly accelerated cooling. This makes the proper hardening and tempering of the steel, particularly in heavy masses, much easier and more certain than it is in plain nickel steels. Unfortunately, these advantages are to some extent counterbalanced by difficulties; the steel is subject to what is known as "temper brittleness" if it is not adequately quenched after tempering, while there are also some troubles, which were serious during the war, from hair cracks and so-called "flakes." These difficulties have, for the time being at all events, set steel makers against this particular type of alloy steel. Its value, however, is so great that efforts to overcome the difficulties are certain to be made, if not in this country, then abroad. It is in fact already claimed that temper brittleness has been overcome.

More recently, chromium has gained still greater importance as the essential ingredient of the rust-resisting or "stainless" steels and irons. In these most valuable and important materials chromium is not only an essential ingredient, but it is present to an important extent. In the nickel-chrome steels the percentage of chromium rarely exceeds unity; in the "stainless" alloys it is generally present to the extent of 12 or 14 per cent. This fact, and the contention that it must be introduced in a particularly refined and expensive form, is given as the reason for the high price of these materials. Unfortunately, this high price serves to limit most seriously the possible uses and applications of "stainless" iron and steel. Over and over again, desirable uses of non-rusting steels are ruled out on account of cost, and it is not unreasonable to inquire how far this high price is unavoidable or results from a business preference for high prices on a restricted output to an enormously wider market at much lower prices. Non-corrodible material is of such enormous importance that any restrictions upon its use and development, other than those arising from natural causes, must be deplored as constituting a serious hindrance to the progress of engineering generally. Furthermore, these materials are a British invention and are largely made in England, so that their exploitation on the largest scale becomes a matter of national interest. If we assume that the high price of chromium steels is mainly due to the high cost of the chromium, the inference is that it is a matter of first-rate importance to secure the reduction of this price. There is, first, the question of the fuller exploration and development of natural sources, particularly of those within the Empire. It might well be asked, what or how much has the Imperial Mineral Resources Bureau done to assist so important a matter? In more normal times we might perhaps be content to leave this work to private enterprise under the stimulus of high prices, but times are still far from normal, and it is a matter of very real national importance and one which may, in the very near future, become in the narrowest sense of the word, a matter of a "key industry." There is the further question of the methods of treatment of the chromium ore and its reduction and refinement to the state in which it can be introduced into the steel. This, again, is a question with which the research laboratories of the interested steel makers have no doubt busied themselves. But the whole question is so intimately tied up with business interests that there is room for doubt, at least, whether these efforts have been as keenly pushed or as fully utilised as they might be. Naturally enough, very little information on these matters is forthcoming, so that it would be interesting and useful if this question could be investigated outside the circle of those commercially interested, in order that entirely unbiased and publishable knowledge might be obtained.

The high cost of the chromium steels is, however, leading to important developments in other directions. These are inspired by the desire to avoid the use of massive articles of chromium steel, and thus to eliminate their excessive cost, by utilising the rust and corrosion-resisting powers of chromium in the form of thin surface layers. Two lines of advance have been opened up. One depends upon the treatment of the surface layers of ordinary steel by a process analogous to cementation, with this difference, however, that, while in ordinary cementation the surface layers are impregnated with carbon, in the new process they are impregnated with chromium—the surface of the steel is "chromised." Important progress along this line has been made in America, and it may be that for many purposes such "chromised" material will prove as useful, in its way, as case-hardened steel. In another direction, which has been chiefly pursued in Germany and also in America, the purpose is not to impregnate the surface layers of steel with a certain proportion of chromium, thus rendering them more or less "stainless," but to coat the surface electrolytically with a layer of pure chromium. This type of coating could, of course, scarcely be applied to the same class of uses for which "chromised" steel or actual chromium steel can be employed, since even a slight amount of wear would penetrate the plated coating. For many purposes, however, chromium-plated steel, and indeed many other metals, should prove extremely valuable. If it is possible to obtain adherent and coherent coatings of chromium commercially at a moderate cost, such coatings should offer many advantages as compared with nickel-plating, and probably even as compared with silver-plating, since chromium is much harder and of a good white colour. We believe that chromium plating is being keenly studied in this country; if so, it is all to the good, not only for its own sake, but because it will help to stimulate progress, and particularly price reduction in "stainless" steels. Steel which is not only incorrodible, but strong and tough, is too important a material to be reserved for table cutlery and golf clubs.

Literature.

Materials and their Application to Engineering Design. By E. A. ALLCUT and E. MILLER. London: Charles Griffin and Co., Limited. Price 32s. net.

BETWEEN treatises on the purely metallurgical aspects of engineering materials and text-books on their physical and mechanical properties and the determination thereof there is a very considerable field, embracing matters of scientific and practical knowledge, which has not so far been quite adequately and satisfactorily covered by any volume with which we are acquainted. Messrs. Allcut and Miller, the one associate professor of thermo-dynamics at Toronto University, the other a metallurgist associated with a Birmingham firm making furnaces, have endeavoured, and in our judgment have done so with a very good degree of success, to supply the want. Their volume is primarily intended, not for students at technical colleges or universities, but for engineers, designers and others. It has been prepared from the standpoint of works practice rather than that of the class room, and throughout its five hundred odd pages it leans heavily towards the engineering as opposed to the metallurgical aspects of its subject.

Following two short introductory chapters of no particular importance or value, we find four chapters devoted to a consideration of the mechanical testing of materials. Tension, compression, torsion and bending, impact testing and the measurement of hardness, are discussed in a manner which, except for its straightforwardness, is scarcely to be distinguished from that adopted in any good book on the testing of materials, although the outlook is necessarily restricted by considerations of space. The seventh, eighth and ninth chapters contain an enlightening account of the chemical and micrographical aspects of the common ferrous and non-ferrous metals and alloys, and are couched in a style which should appeal very greatly to the engineer who derives confusion rather than knowledge from other authors having a purely metallurgical objective. The heat treatment of steel and other metals is dealt with at fair length in the tenth chapter. The theoretical considerations underlying heat treatment, so far as they are understood, are clearly explained, and close consideration is given to the practical methods of carrying out the process. At first sight the inclusion in this chapter of several pages on forging and drop stamping may seem an incongruity, but it is very readily explained by the fact that, according to the authors, forgers and drop stampers are the greatest offenders in that ill-treatment of steel which it is one of the principal objects of heat treatment to palliate or cure. The eleventh to sixteenth chapters are descriptive of the anatomy, characteristics and applications of various classes of iron and steel and non-ferrous metals and alloys. The seventeenth chapter gives us an interesting but altogether too brief discussion of the inspection of materials, raw and partly manufactured. There is little, if any, pure science in it, but there is much of that practical knowledge which the engineer acquires only by experience. The eighteenth chapter deals with non-metallic materials, such as timber—including glued joints and plywood—fabrics of various kinds and cement. The information given is brief and is admittedly included for the sake of completeness, but for the purposes of most mechanical engineers it will probably be found sufficient. The nineteenth chapter, entitled "Examples of Practical Application," discusses the materials used for, and the methods of testing, tubes, gear wheels, springs, wire ropes and other items, and, in addition, includes notes on welding, brazing, season cracking, &c. The final chapter contains a very useful collection of tables of value in the testing and application of materials.

The book is throughout distinguished by its directly practical outlook. In places, perhaps, it may be argued that it is even too practical. The statement, for instance, is made in the second chapter that in marine connecting-rod bolts the plain parts are often turned down to the same diameter as that at the bottom of the thread, with the object of "preventing all the stretch imposed by the load from being concentrated within the comparatively short threaded length." That statement will not bear theoretical—or even practical—analysis, for no amount of difference between the two diameters could possibly relieve the heavier sectional length of *all* stretch. Again, it is remarked that timber is used in aviation work on account of its comparative lightness. It is, however, well known, both theoretically and practically, that a metal aeroplane strut can be made actually lighter than a wooden one of the same primary strength. The real reason for the employment of wood goes far beyond any consideration of mere specific gravity. It rests, in part, on practical difficulties connected with the fabrication of the members, and in part on theoretical considerations affecting their local strength. Nor does the authors' remark that in aviation work wood "is being superseded to some extent by the use of aluminium alloys and thin steel tubing" do anything like justice to the large volume of theoretical and practical investigation which has been

done on the employment of metal in aircraft construction. In addition, it is very far removed from being a true indication of the trend in aircraft design, for at the present moment the employment of metal on highly developed lines is receiving the closest attention of many of our leading aeroplane firms.

The book might be criticised at various other points for certain minor omissions and slightly defective statements, but to do so would be unfair to the authors, and might possibly turn some readers away from a work which, looked at as a whole, decidedly deserves their attention, and which is likely to prove of great value to them.

The Metallurgy of Steel. By F. W. HARBORD and J. W. HALL. Two volumes. 32s. each net. Seventh Edition, thoroughly revised. C. Griffin and Co., Limited. 1923.

THERE is, we are confident, no better book on the manufacture and working of steel than Harbord and Hall's. It has been before the world for a good many years, and successive editions have stood the tests of use and run the gauntlet of criticism and have come out scathless. Mr. Harbord, as everyone knows who knows anything of such matters, is one of the select company of our leading practical metallurgists, whilst Mr. J. W. Hall, of Birmingham, has a knowledge of steel works practice which is unsurpassed. We do not say these things in any spirit of flattery, but as sober statements of well-known facts. From such authors we might expect a work of a thoroughly practical kind, a work as suitable for the manufacturer as for the student, and one which may be placed upon the library shelves as a safe source of reference. We forget when the first edition appeared, but as the book has been kept constantly up to date, and as this is only the seventh revision, it cannot have been very many years ago. The increasing size of the volumes is an indication of the progress of steel. Exclusive of the index and appendices, the first volume of the present edition—that devoted to Metallurgy, and the work of Mr. F. W. Harbord—requires just five hundred pages, whilst the second volume—that on Mechanical Treatment, by Mr. J. W. Hall—takes, exclusive of its index—for each volume is quite complete in itself—some thirty-five pages more. The second volume has increased more than the first, for it is now over one hundred pages longer than in 1911—the fourth edition. It has, as a matter of fact, been practically re-written throughout, and it now contains a concluding chapter of exceptional general interest. This chapter discusses the past and future of the steel trade, and it has been written, the author tells us, "lest an impression should be given that merely to provide mechanical appliances will ensure a thriving industry." Mr. Hall traces the origin and progress of steel manufacture in the chief steel-making countries, and shows that "its growth has depended on historical and geographical facts, transportation problems, and financial, political and ethnological circumstances." This review of the past being completed, Mr. Hall sets out conditions as they exist to-day and draws some conclusions as to the future from them. He takes a happy view of the prospects. He sees no inherent reasons why France or Germany should be able to export iron or steel more cheaply than this country, particularly pig iron, and he holds that Northamptonshire and Lincolnshire ores can be worked as cheaply as those of Lorraine. It is in our ability to win our coal cheaply that our prosperity depends. He concludes with these words: "If the capital needed for reconstruction is to be attracted, the British workman must abandon trade union regulations, such as, by restricting output, increase the incidence of dead charges, and make it increasingly difficult to compete for the trade of the world. At present the British steel worker produces only 46 tons per man per annum, against 60 tons produced by the German and 76 by the American."

It is very fitting that an important work should come to an end with a chapter of the kind, and we are glad, indeed, to find in a text-book a recognition of the importance of technological history. But purchasers will buy the work not for such a chapter—though we dare swear it will be one of the first read—as for the technical matter it contains. With regard to that we need only say that neither the authors nor the publishers have spared themselves trouble or expense in their efforts to bring the work up to date. Revision, as we have already observed, has meant in parts wholesale re-writing, and we may add that it has meant also the provision of many new illustrations. Hence "Harbord and Hall" remains, what it has been for many years, the standard British book on the metallurgy and mechanical treatment of steel.

SHORT NOTICES.

Civil Engineering Geology. By Cyril S. Fox. Crosby Lockwood and Son. 1923. Price 18s. net.—This brightly written and excellently illustrated book can certainly be recommended to the engineer who wishes to gain information with regard to the geological aspects of various engineering schemes and operations. The nucleus of the book was a paper on "Some Engineering Aspects of Geology," which the author prepared some two years ago for the then newly formed Institution of Engineers in India, and many of the most interesting photographs are of the mountains and rocks of that great Continent. There are three separate sections, dealing with water supply and irrigation, field operations, and building materials, respectively. In the first part general considerations relating to rainfall are dealt with, and other chapters are devoted to rivers and canals, reservoirs, infiltration channels and wells, and artesian conditions. In the second part, the field operations familiar to civil engineers are described, and are appropriately illustrated by diagrams and photographs. The subjects covered include retaining walls, tunnels and shafts, the stability of hillsides, and quarrying and mining, while this section closes with a short chapter on building sites. The remainder, and larger part, of the book is reserved for a detailed account of building materials, their occurrence and their physical properties. After a description of the mode of occurrence of rocks, the author enumerates the principal rock groups and the common rock-forming minerals, together with their physical properties. In the concluding chapter the subject of choice of materials is discussed. The latter part of the volume is notable for the many photo-micrographs of rock sections, which are excellently reproduced, and for the well-arranged tables of rock groups and rock-forming minerals.

The Lathe Users' Handbook. By C. M. Linley. London: Scott, Greenwood and Son. Price 7s. 6d. net.—This is a useful, but far from complete, little book of practical advice regarding the operation of lathes. While the information which it gives—all of it, we are told, the result of experience and thoroughly tested—should be distinctly useful, it is somewhat disjointed and not always quite clearly expressed. Nevertheless many will, we feel sure, welcome it as a practical guide, although we think it will appeal more to the student and apprentice than to the works manager, foreman, toolmaker, and turner, whom the author also had in mind when he wrote it. It contains an all-too-brief chapter criticising lathe design. In it the author laments the lack of agreement among lathe makers regarding the "hand" of the facing screw slide, remarking that about as many lathes are fitted with a left-hand screw as a right-hand at this point, and that the consequence may be disastrous when a turner accustomed to one style has to change to a lathe fitted with the other. He also criticises the common practice of making the index disc on the same screw of small size; the frequent employment of a clamping device for the tailstock barrel which is such as to affect the alignment of the back centre; the fondness shown by British makers for the gap bed; the use of non-removable handles supposed to be balanced; the adoption of very short slides in the tool-box and the driving of the leading screw and feed shaft from a common source. He does not, however, reserve all his criticism for British lathes, but passes censure on the American lathe, a common failing of which, he says, is lack of durability and driving power.

Oil Fuel Burning at Sea and on Land. By James Sandford Gander. Price 15s. James Munro and Co., Limited, Glasgow.—The author of this book writes upon a subject with which he is familiar by reason of his practical experience with oil-burning installations at sea, and the volume contains much useful and practical information and should be of service not only to the marine engineer, but to all engineers who have to do with oil fuel burning in its various applications. The first part of the book is devoted to a brief description of the origin of oil fuel, its geology and the methods of oil drilling. The various oil fuels in commercial use are enumerated, and after a chapter on the evolution of oil burning, the principal modern oil-burning systems are described and illustrated, as also are the oil-burning auxiliaries. Particularly interesting sections of the book are those chapters dealing with oil bunkers, their maintenance and cleaning, and a description of a voyage on oil fuel with an installation of the pressure jet type. The various rules and regulations drawn up by the classification societies and governing oil fuel burning installations at sea are quoted, and a short account of the use of oil fuel in industrial work is given. We note with satisfaction that it is the author's intention to revise this work annually, so that every advance made in this rapidly growing branch of engineering technology may be recorded.

Wireless for the Amateur. By J. Roussel. London: Constable and Co. Price 14s. net.—This book, which has been translated from the French, contains a good deal of practical information of value to those who are interested in wireless communication. It also deals with theoretical considerations, but in the main it covers practical work, such as that which appeals to the average experimenter. Constructional details are given of many pieces of wireless apparatus which the author has constructed, such as tuners, frame aerials, and so forth. It appears, however, that the original volume, published in French, was written before the advent of wireless telephony, or, at any rate, before broadcasting commenced. It is stated in the translator's preface that the original volume only dealt with resistance-coupled high-frequency amplifiers, and as that method of coupling valves is unsuitable for use on short waves, the translator has added a chapter on amplifiers suitable for reception on any wave length down to about 150 m. On the whole, the book is quite a useful publication. Its main disadvantage, probably, is that metric measurements are given, but a conversion table has been included to enable the reader to convert the metric units into English units.

Electro-chemistry related to Engineering. By W. R. Cooper. London: Constable and Co. Price 12s. 6d.—The author of this book deals in a concise manner with many interesting electro-chemical problems which are related to engineering. He considers, among other things, electrolytic corrosion by stray earth currents, the effects of superimposing alternating currents on direct currents, the corrosion of brass, electric osmosis and cataphoresis, electrical precipitation of dust, smoke and fumes, and electro-culture. Electrical and mechanical engineers should, we think, find the volume interesting and instructive. It is written on quite simple and straightforward lines, and even those with very little knowledge of electro-chemistry should have no difficulty in understanding it.

Pulverised and Colloidal Fuel. By J. T. Dunn. London: Ernest Benn Bros., Limited. Price 25s. net.—This book deals mainly with principles, but it also describes a number of pulverised coal plants. It is probably the most extensive book that has so far been written on the subject, and the section on colloidal fuel is of special interest. Although many descriptions of pulverised coal plant have been published, there is, we think, a good field for the volume.

BOOKS RECEIVED

The Story of a Great Schoolmaster. By H. G. Wells. London: Chatto and Windus, St. Martin's-lane, W.C. 2. Price 4s. 6d. net.

Ministry of Public Works, Egypt: Report on the Work of the Physical Department for the Year Ending March 31st, 1923. Cairo: Government Press.

Clubs, 1924. Edited by E. C. Austen-Leigh, M.A. London: Spottiswoode, Ballantyne and Co., Limited, New Street-square, E.C. 4. Price 7s. 6d.

Marine Engineering Practice. By Engineer-Commander F. J. Drover, R.N. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 21s. net.

Ministry of Public Works, Egypt, Physical Department: The Rains of the Nile Basin and the Nile Flood of 1913. By H. E. Hurst. Cairo: Government Press.

The Housing Problem and the Way Out, with Notes on Unemployment. London: The Brotherhood Movement (Inc.), 37, Norfolk-street, Strand, W.C. 2. Price 6d.

The Marine Steam Engine. By the late Richard Sennett and Sir Henry J. Oram. Fourteenth edition. London: Longmans, Green and Co., 39, Paternoster-row, E.C. 4. Price 26s. net.

The Electronic Theory of Valency. A General Discussion held by the Faraday Society, July, 1923. London: The Faraday Society, 10, Essex-street, Strand, W.C. 2. Price 10s. 6d. net.

The Physical Chemistry of the Photographic Process. A General Discussion held by the Faraday Society, May, 1923. London: The Faraday Society, 10, Essex-street, Strand, W.C. 2. Price 12s. 6d. net.

The Colliery Managers' Pocket-book, 1924. Edited by J. V. Elsden and H. Greenwell. London: The *Colliery Guardian*, 30–31, Furnival-street, E.C. 4. Price 3s. (cloth), 4s. 6d. (roan, with gilt edges).

Modern Mechanical Engineering. Six Volumes. Edited by Professor A. H. Gibson and Mr. A. E. L. Chorlton. London: The Gresham Publishing Company, Limited, 66, Chandos-street, Covent Garden, W.C. 2. Price 14s. each volume.

SIXTY YEARS AGO.

IN a leading article, entitled "The Manufacture of Bessemer Metal," published in our issue of January 15th, 1864, we gave some particulars, possibly now forgotten, regarding Bessemer's first experiment at converting cast iron into steel. Although he was not an ironmaster, nor trained to the routine of ironmaking, he argued that as decarbonisation of pig iron was the essential factor in converting it into malleable iron, it would be better to bring the oxygen into contact with the iron than the iron into contact with the oxygen, as was done during puddling. Obtaining a small, powerful blast engine and a quantity of pig iron, he proceeded to test his idea at Baxter House, St. Pancras. A vessel lined with fire-clay was prepared to receive the molten metal delivered from a cupola, and to it a supply of high-pressure air was led. The mouth of the vessel was partially closed by an ordinary cast iron pavement coal-hole cover suspended by a chain. The metal had not been long in the converter, however, before the cover and a large part of the chain were dissolved by the intense heat liberated by the decarbonisation process. The air cock was too close to the converter to permit its being approached by anyone with the object of shutting it, but the "fury of the decarbonisation" subsequently subsided of its own accord—before, it is stated, the fire-engines arrived. The result of the experiment was unknown, but was such as to encourage the inventor to proceed. On a second attempt the product was unmistakably steel. Mr. George Rennie saw the process being carried out at Baxter House, and persuaded Bessemer, at less than a week's notice, to prepare a paper on his work for presentation before the British Association at Cheltenham. That paper, entitled "Making Steel from Cast Iron without Fuel"—or words to a similar effect—was, before being read, received with much scoffing, but immediately after it had been presented, James Nasmyth and others expressed their sense of the importance of Bessemer's process. *The Times'* reporter asked for, and received, a full copy of the paper, and "within less than forty-eight hours afterwards, all Sheffield was aghast at its contents." The Ebbw Vale Company offered £50,000 for the patent, but the offer was refused. It seems strange that all this time the success of the process was dependent upon a factor with which Bessemer was wholly unacquainted, namely, that his metal broker had supplied him with pure Blaenavon pig iron. Other irons came to be tried, but the steel produced was "honeycombed, rotten, altogether bad." The process fell to a discount, and its success seemed almost hopeless. After two years of trial and investigation, it was found that no iron containing more than about one-tenth of 1 per cent. of either sulphur or phosphorus would make good Bessemer steel. That discovery, combined with the use of manganese to counteract the effect of burning by too prolonged an application of the blast, resulted in the final commercial success of the process. It is recorded that, following the demonstration of the advantage obtained by the employment of "manganesian iron," "that crotchety and irascible metallurgist, Mr. Mushet," took out a patent for its improved use, but "wisely allowed his patent to lapse by non-payment of the third year's stamp."

New Switchgear at the Neasden Power Station.

IN the series of articles on "Developments in Power Station Design," which appeared in THE ENGINEER between 1922–1923, we referred to the large switchgear contract which the General Electric Company, of Witton, Birmingham, was carrying out at the Neasden power station of the Metropolitan Railway. The work has been completed some considerable time, and we are now in a position to describe it in detail.

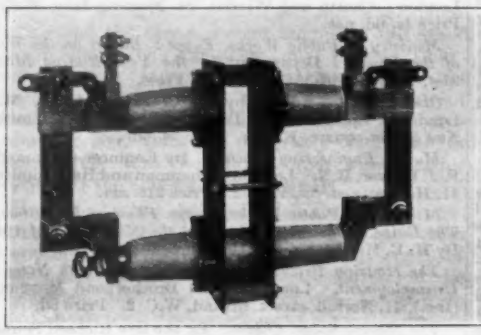


FIG. 5—1000 AMPERE ISOLATING LINK

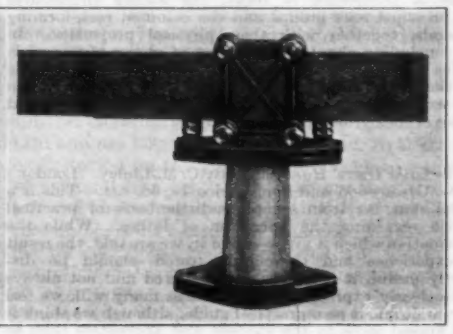


FIG. 6—COMBINED EXPANSION CLIP AND JOINT

All the switchgear necessary for the control of the alternators, feeders, transformers, and auxiliary circuits at the Neasden power-house was included in the contract. The main high-tension three-phase switchgear was designed for a potential of 11,000 volts and a periodicity of 33⅓ cycles per second, and it controls one 12,000-kilowatt turbo-alternator, five 5000-kilowatt alternators, thirteen 300-ampère outgoing feeders, two outgoing feeders for the auxiliary extra high-tension bus-bars, one 350-kilovolt-ampère works transformer, and two bus-bar couplers.

The generator control board, which is designed for the remote control of the switchgear, is situated on the top floor of the building and is shown in Fig. 1 on page 70. The panels are composed of 1¼in. polished enamelled slate and all the instruments are finished in nickel and black. The 12,000-kilowatt generator panel is equipped with an ammeter, a power factor meter, an indicating watt meter, a frequency meter, a recording watt-hour meter, and an integrating watt-hour meter. The equipment also consists of a controller for operating the oil switch and red and green signal lamps for showing when the switch is closed and opened, and a blue lamp for showing when the isolaters have been earthed. The generator is protected by McColl protective gear, which we have already described. The five 5000-kilowatt generators are equipped with the same instruments, &c., as the 12,000-kilowatt panel, but for these panels Merz-Price protective gear is used, as it was already in existence on the old switchgear. All the generators are provided with automatic voltage regulators, which are fitted at the extreme ends of the generator switchboard. The generator and feeder switchboards have single line diagrams or mimic bus-bars composed of nickel-plated strips and solenoid operated indicators, which indicate whether the isolating links are connected to the main bus-bars or to the "hospital" bus-bars.

The outgoing feeder panels shown in Fig. 2 on page 70 are equipped with three ammeters, a double-pole overload relay, a single-pole earth relay, and a watt-hour meter, a controller for operating the oil switch, red and green signal lamps, and a blue signal lamp to indicate when the outgoing links have been earthed. The equipment for the outgoing feeders for auxiliary bus-bars is practically identical with that of the other feeders, a special feature being that two oil switches cannot be closed simultaneously, this arrangement having been adopted so that each section of the bus-bars cannot be in parallel with the extra high-tension auxiliary board, as the bars of that board have a smaller section than the main bus-bars. The two feeders from the extra high-tension auxiliary board control two 15,000-kilovolt-ampère transformers which supply the power for all the auxiliary gear of the engine-room, boiler-house, compressor house, ash plant, and two station auxiliaries.

The transformers, which are star-delta connected and have a ratio of 11,000/440 volts, are protected by means of the McColl protective gear, which opens the switches both on the high and low-tension sides. The works 11,000 to 360-volt transformer, 350-kilovolt-ampère panel is equipped on the same lines as the 1500-kilovolt-ampère transformer panels. The bus-bar coupler panels are provided with operating controllers for the oil switches, which are non-automatic.

It will be remembered that the switchgear is erected in a switch-house which is quite separate from the main power station. The top floor of this switch-house is equipped with the main and hospital bus-bars, which are divided into two sections, namely, east and west bars, which can be coupled together through couplers. There are also two hospital bus-bars which run parallel with the main bus-bars. If necessary, the hospital bus-bars can be connected together by isolating switches. The bus-bars are built up of four sections, composed of 4in. by ¼in. hard drawn high conductivity copper. All the ends of the conductors are clamped together, and no holes are drilled in the bars. They are built up against one another and are held by the General Electric Company's patented expansion clamp, as shown in Fig. 6. These clamps take up all the longitudinal movement set up by changes in temperature. The next floor contains the cubicles, as illustrated in Fig. 3. Each cubicle contains duplicate isolators, as shown in Fig. 5; instrument transformers, see Fig. 7; and oil switches, shown in Fig. 8, the switches being arranged immediately below the respective bus-bar chambers. On the floor below are the isolating switches for the incoming side of the alternators and the outgoing side of the feeders, together with the necessary cable boxes. All the cubicles are built up of brickwork, with concrete insets and division pieces for the reception of the various parts of the switchgear. The front of each cubicle is protected by sheet metal plates.

Switchgear has been provided for connecting the star point of the six machines to an earthing bus-bar. Each of the cubicles for this purpose is of the sheet steel type, and contains a single-pole isolating switch and a single-pole non-automatic oil switch for connecting the star point to the earthing resistance. These cubicles are adjacent to the alternators in the turbine room. There are also six automatic field switches and discharge resistances. These are arranged in pillar form with an automatic circuit breaker and a non-inductive resistance in a steel case with an emergency push-button switch protected by a glass window, which is broken in the event of a fault developing on the alternator, and these automatic switches are controlled from the control board in the switch-house.

The 440-volt switchboard, shown in Fig. 4 on page 70, has been designed for operation on the low-pressure side of the three-phase system. It will be gathered that the switchboard is of the sheet steel type, and is arranged to control the incoming low-tension side of the 1500 kilovolt-ampère transformers, a 720 horse-power feeder for the engine-room, two 470 horse-power feeders for the boiler-house, a 250 horse-power feeder for the air compressors, and two

FIG. 7—INSTRUMENT TRANSFORMER AND ISOLATING LINK CUBICLES

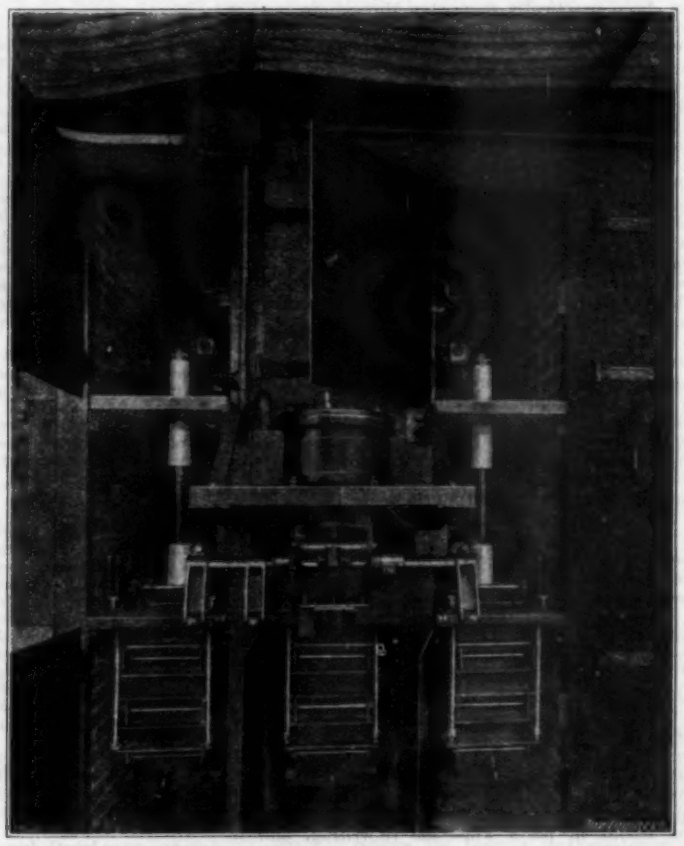


FIG. 8—MAIN OIL SWITCH

station auxiliaries. The incoming feeders from the transformers are equipped with three isolating switches, and a triple-pole oil switch, with three overload trips and one main shunt trip, the shunt coil trip being associated with the McColl relay fitted on the extra high-tension auxiliary switchboard. The outgoing feeders are equipped with three isolating links and one triple-pole oil switch, with three overload trips. The compressor feeder has a no-volt attachment in addition to the other trips on the oil switch. The boiler-house distribution board is of a similar type to the 440-volt board described, and has two incoming feeders, each of 470 horse-power capacity running from the 440-volt control board. There is a circuit for the ash-plant motors and water softeners, two circuits for the forced draught fan motors, two for the stoker motors, and two circuits for fan distribution boards. Each of these circuits is equipped with three isolators and one triple-pole overload oil switch, with three overload trips. The ash-plant stoker motor and forced draught motor feeders also have a no-volt trip.

The 440-volt switchboard for the distribution of power in the engine-room is of the sheet steel type, with one incoming feeder and two circuits for a 130 horse-power feed pump motor and a 590 horse-power condenser pump motor, the circuit equipment being similar to that of the two other low-tension boards. Another sheet steel switchboard situated in the control-room is a 365-volt board and the equipment consists of three isolating switches and a triple-pole oil switch, with three overload trips and one shunt trip, which is operated in conjunction with a McColl relay mounted on the extra-high-tension switchboard.

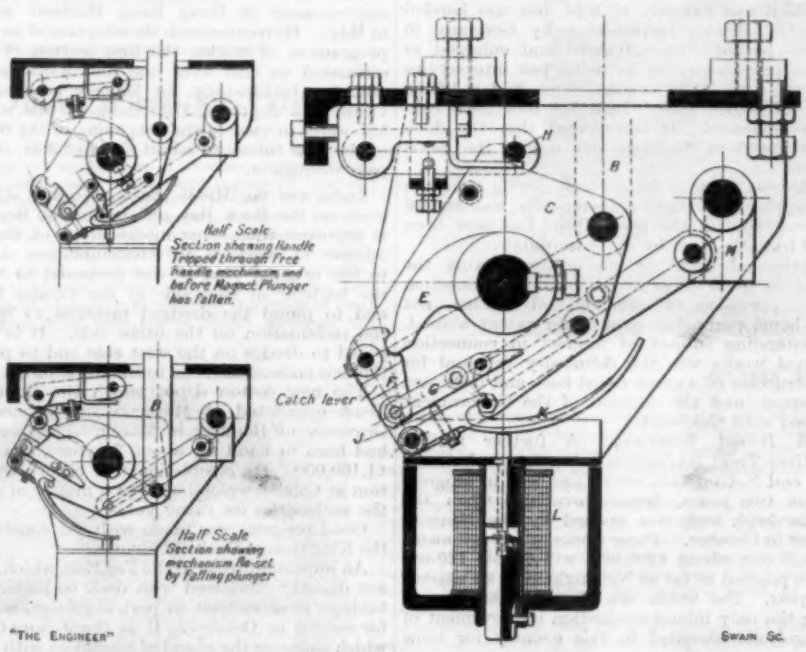

Half Scale
Section showing Handle Tripped through Free handle mechanism and before Magnet Plunger has fallen.
Catch lever
Half Scale
Section showing mechanism Re-set by falling plunger
"THE ENGINEER"
SWAIN SC.

FIG. 9—MECHANISM OF MAIN OIL SWITCH

Another section of this switchgear was arranged to line up with an existing flat type white marble switchboard, each panel being equipped with similar apparatus to that described.

The cable portion of the contract was carried out by Pirelli General Cable Works, of Southampton. Besides the cables, the contract included the supply of the cable racks, dividing boxes and the rubber tails required for connecting up the various apparatus to the switchgear. All the instrument connections between the switch-house and engine-room are carried through multi-core cables. Another section of the contract covered the installation of complete relay apparatus at the sub-stations, the apparatus being designed to protect the whole of the existing feeders from all faults arising from short-circuit overload or earths. The protective gear is similar to that erected in the main station and includes relays, integrating watt meters, &c. Six sets of the General Electric Company's engine-room telegraphs were also installed in the main station.

The main oil switches, shown in Fig. 8, are designed to accommodate insulators for circuits up to 33,000 volts. They are operated by an electrical remote control system, and are capable of dealing with short-circuit currents of 350,000 kilovolt-ampères, based on the short-circuit current of the system. Each switch has a sufficient safety factor as regards breaking capacity to deal with the maximum instantaneous short-circuit current, if this happens to coincide with the instant of rupture. All the switches are subjected to a thorough pressure test, the standard test voltage being equal to at least 2000 volts plus 2½ times the voltage between phases. The porcelain insulators were tested at a voltage equal to at least three times the working voltage. The head of oil above the switch break is 11in., and the total length of the break, which is a double one, is 12in. The quantity of oil used per phase is 22 gallons, or 66 gallons in all. A strong steel framework, which forms the front of a three-cubicle structure, supports the closing solenoid, the main framework of the cubicle being composed of stout channel and angle iron, whilst brickwork or concrete partitions divide the phases.

In the past many switchgear accidents have occurred as a result of the tanks being blown open when switches were operated under short-circuited conditions, but the exceptionally strong channel and angle iron reinforcements used in the construction of the General Electric Company's switches are claimed entirely to prevent accidents of this kind. The tanks are lined with three or five-ply birch, which is a non-resinous wood. Moreover, the tanks fit into a deep recess in the top frame of the switch, and the recess is fitted with a thick gasket, with the result that the emission of fumes from the tank is impossible. Vent pipes of large diameter lead from the tops of the tank to the outside of the building, so that the internal and external pressures are equalised. The tanks are held in position by substantial steel bolts, which secure the tanks firmly to their frames. Bolts are also provided to keep the tank clear of the contacts when the tank is lowered for the purpose of inspecting the contacts.

The movable contacts are wedge-shaped, whilst the fixed portions are of the controller finger pattern. Exhaustive tests are said to have shown the superiority of the rounded form of contact over the flat contact, which is usually employed. Substantial sparking contacts are also supplied to enable a high-speed break to be obtained before rupture. No flexible connections of any kind are used. The normal speed of the break is approximately 10ft. per second, *i.e.*, twice 5ft., this latter figure being the speed of movement of the mechanism, but in special cases a still higher speed can be attained. When operating under short-circuit conditions the magnetic blow-out effect of the current increases the speed of the break even more. As the moving parts of the switch are heavy, air dashpots are provided in order to avoid the switch being damaged by being arrested too suddenly. The switches are provided with overload releases and biassed discriminating relays working on McColl's system. Red and green signal lamps are fitted on the control board to show whether the switch is closed or open.

The method of operation will best be understood from Fig. 9. The right-hand drawing shows the condition of the mechanism when it is in the closed position, and when it is held by the restraining catch H the weight of the moving contacts, &c., produce a clockwise torque on the shaft D, to which the main driver E is keyed. At each side of the main driver there is a plate C which is not keyed to D, but which is locked to it by means of the locking lever F which engages with the nose of the driver E. As long as the member F is prevented from being rotated by means of the driver E, the mechanism is locked by the toggle links G, which are set in the dead centre. The setting of the links G is controlled by the adjusting screw J, which is carried by the trip lever K. When the trip coil L is energised the plunger rises, thus lifting the trip lever K and pressing the toggle G out of the dead centre. This frees the locking catch F, which rotates and releases the nose E. In its upward travel the nose raises the retaining pin H, thus releasing the side plates C, as shown in the upper left-hand diagram in Fig. 9. The plunger of the closing magnet then rotates the plates C until they overtake the nose E, when the nose enters the detent of the locking catch F, thus rotating the latter into the position shown in the lower left-hand drawing. The toggle links G again fall into the dead centre, thus locking the plates C to the nose E. The mechanism is now re-set ready for the next closing operation, and when the closing magnet is energised the plunger draws up the lock B, thereby rotating the shaft D and closing the breaker.

It will be noticed that the mechanism can be released at any part of the closing stroke. A socket M is provided for the insertion of a steel bar for use when it is desired to operate the circuit breaker manually, as, for instance, when it is necessary to inspect the contacts or in the case of emergency. The controller, which can be situated in any convenient position, is of the drum type, the handle being brought to the mid position by means of a return spring. To close or open the main switch the controller handle is simply brought to the proper position, and after it has been held there for an instant it is released. The drum is then automatically brought to the off position, thus breaking the operating current circuit. From the foregoing it will be seen that the switch is operated on the free handle principle, and directly the tripping circuit is energised in any part of the upward travel of the core of the closing solenoid the switch is automatically released. Moreover, even if the handle of the controller be kept in the closing position the main switch will not close a second time, for before the switch can be made to close again the controller handle must be brought to the off position.

The McColl control gear which is used for the protection of the generators and transformers has given entire satisfaction. During the time the change over from the old to the new switch-house was being made a temporary unprotected underground cable broke down, thus producing a very heavy short-circuit upon the system, and as a result there was a sudden surge back of power from the rotary converters in the sub-stations into the generators. The McColl relays and other protective gear immediately operated, thus entirely isolating the fault. The surge on this occasion also caused a power transformer to break down, but it was at once isolated by the McColl gear.

Harbours and Waterways in 1923.

THE year 1923 witnessed but little more activity in port construction and development than the two preceding years. At home the numbers of Bills having reference to dock and harbour works dealt with in the session 1922–3 was smaller than ever before in recent times, and the present session of Parliament shows no improvement in this respect.

The attempts on the part of the Government to encourage and expedite the execution of public works in the interests of employment did not result in any marked increase of activity so far as the ports of the United Kingdom are concerned, although in some few instances works, which otherwise would have been postponed, were put in hand. The most important arrangement in this connection was the undertaking of the Government to make a loan of £4,500,000 to the Port of London Authority at interest of 3½ per cent. per annum for thirty years, to enable the authority to begin a big programme of works to which we shall refer hereunder. At the end of the year no part of the works had, however, been actually commenced.

No legislation affecting harbour authorities in any very important manner was carried through Parliament in 1923. The Oil in Navigable Waters Act, 1922, which came into operation in January, was met successfully by dock owners and shipowners, who combined to introduce appliances calculated to deal adequately with the oil nuisance.

In July the International Navigation Congress, which met in London under the presidency of Lord Desborough, brought together representatives of ocean and inland navigation, ports and waterways from all parts of the world. The members paid visits to many of the principal ports of the kingdom, including the Port of London, Southampton, the principal South Wales ports and Liverpool, and discussed at the meetings of the Congress a long programme of papers and communications.

The United Kingdom.

Port of London.—The Port of London Authority has in preparation plans for a great extension of the Tilbury Docks, at a cost of £5,000,000. It is expected that tenders will be invited for the first section of this project at an early date. The scheme includes an extension of the dock to a length of 6550ft. northwards from the existing south wall, a new entrance lock, 1150ft. long, 130ft. wide, with 56ft. depth over the sills at T.H.W.; and a dry dock, 1150ft. long, 130ft. wide, with 43ft. depth over the sill. The Authority has also decided to remodel the Surrey Commercial Docks, at a cost of about £585,000; a portion of this work is already in hand. It is also intended to begin at once the construction of a floating landing stage and new railway station at Tilbury.

The Mersey and Manchester Ship Canal.—The

Mersey Docks and Harbour Board experienced increased difficulty in maintaining the channels at the Mersey entrance, and a commencement has been made with the revetment of the Crosby Channel as an extension of the Taylor's Bank revetment. The Gladstone Dock works still form the chief item of capital expenditure which the Board has in hand. The walls of the new 130ft. wide entrance lock are nearing completion, the gates are being erected, and the construction of sheds at the new No. 1 Dock has been begun.

The improvements at the Liverpool landing stage are now completed and in use. On the Birkenhead side of the river the new Alfred Dock entrance is the principal work in hand.

The Manchester Ship Canal Company is seeking parliamentary sanction to deepen the canal between Eastham and Stanlow, a distance of about 4 miles, by 2ft., thus giving 30ft. of water in that portion of the navigation. This deepening is primarily intended for the benefit of the oil and petroleum spirit traffic to the new petroleum dock at Stanlow. New wharves and transit sheds are being constructed at Manchester, and the building of three large warehouses is to be commenced shortly at Trafford Park.

Bristol Channel and South Wales Ports.—The Bristol Docks Committee embarked on an extensive scheme to cost £1,000,000. Tenders were invited for the construction of a new eastern arm of the Royal Edward Dock at Avonmouth to cost £600,000, and the balance of the authorised expenditure will be devoted to the construction of transit sheds and the provision of equipment.

By the transfer of the undertaking of the Swansea Harbour Trustees to the Great Western Railway Company, which became effective in June, the control of all the important docks in South Wales and Monmouthshire passed into the hands of the railway company. The company has already decided to spend large sums on the modernising of the mechanical equipment of the South Wales ports and in other improvements. In the autumn a committee of officials of the company, including Mr. Vickery, the chief dock manager, made a tour of inspection of United States and Canadian ports preparatory to the introduction of far-reaching changes in the channel ports A beginning only was made with much-needed replacements, including several new sets of lock gates at Cardiff, a new hydraulic installation at the Bute Docks, and additional coal tips at Cardiff and Barry. At Swansea the inner gates of the King's Dock lock are to be renewed and additional oil bunkering facilities are proposed. The new graving dock at Swansea for Palmers Shipbuilding Company is nearing completion and the ship-repairing yard is in use.

North-East Coast and Humber Ports.—At Blyth the construction of the superstructure of the new coal staiths for the London and North-Eastern Railway Company is in hand, and the Harbour Commissioners are reconstructing a portion of the west pier. At Hull new dock gates and a pumping installation are being provided. At Hartlepool improvements in connection with the coal shipping facilities are being pushed forward. The railway company is also reconstructing the entrance to Tyne Dock, and the West Dunston staiths on the river Tyne, above the bridges, which were completed by the North-Eastern Railway Company before the war, but have not yet been used, are to be opened, the Tyne Commissioners having carried out the necessary dredging in the berths fronting the staiths. At Newcastle the Corporation quay extension is practically completed, and new sheds are being erected. The remodelling and enlargement of the dry docks of Smith's Docks Company at North Shields is nearing completion, and at South Shields the Middle Docks and Engineering Company, Limited, completed the building of two new dry docks and the reconstruction of two others.

Messrs. Swan, Hunter and Wigham Richardson purchased a site on the south bank of the Tees at Middlesbrough for the construction of a shipbuilding and repairing yard. Tenders were invited for the construction of two dry docks on this site, but no decision to proceed with the works was arrived at.

A contract for the extension of the South Dock at Seaham Harbour in Durham was settled at the end of the year, and additions to the coal shipping facilities at the port are to be made.

The London and North-Eastern Railway Company is credited with the intention of spending large sums on the extension of the fish docks at Grimsby.

Southampton.—The most important of the Bills affecting home ports to be brought before Parliament this session is that of the Southern Railway Company. A vast scheme of port development at Southampton is contemplated by the company. Graving docks, larger than any yet constructed, reclamation on a large scale, extensive dredging operations and deep water quays and jetties on the river Test side of the harbour, for the largest Transatlantic liners, are included in the proposals.

The 60,000-ton floating dock which is being built at the Armstrong Yard on the river Tyne for the Southern Railway Company, was not completed last year as was intended, the boilermakers' lock-out having delayed the work. It is, however, expected that the dock will be in position at Southampton early next summer. A large amount of preparatory work for the monster dock, including deep dredging and the construction of dolphins, was completed at Southampton.

Scotland.—The Clyde Trustees have invited tenders for the first section of the Shieldhall docks scheme. This work, if it should be put in hand, will mark the beginning of a very important and costly programme of dock extension which the Trustees have for years past been anxious to carry into effect. The war and the unsettled conditions of the subsequent years have hitherto prevented the Trustees from proceeding with this scheme of development.

Other Ports.—The space at our disposal allows but a passing mention of a few matters of interest at other ports in the United Kingdom. At Holyhead the deepening of the inner harbour by the London, Midland and Scottish Railway Company was completed. The Great Eastern Train Ferries Company, which was formed early in the year with the object of running the wartime channel train ferrry boats between Harwich and Zeebrugge, carried out a part of its construction programme, but the project was hindered by the sinking, during a storm of September 1st just outside Harwich harbour, of the barges carrying the ferry landing bridge, which was being transferred from Southampton to Harwich. The Naval Harbour at Dover was handed over by the Admiralty to the Dover Harbour Board. The Great Western Railway Company put into service the new China Clay Jetty at Fowey Harbour. The Aberdeen Harbour Commissioners are putting in hand various improvements, the estimated cost of which is about £350,000, as a result of Government assistance under the Unemployment Grants Scheme.

Naval Ports.—One of the large naval floating docks which was formerly at Kiel, but was handed over to the British Government by Germany in 1920, was partially reconstructed and enlarged at Chatham, preparatory to its being put into service at a naval port. The original dock had a lifting capacity of 40,000 tons, which has now been considerably increased. It is reported that the dock is to be towed to Singapore for use at the naval base there.

The Medway floating dock, which, during a portion of the war period and until quite recently, was moored at Jarrow Slake in the river Tyne, has now been removed from the river by the Admiralty.

The principal items of expenditure during the past year on naval works were incurred in connection with the provision of increased oil storage, not only at home ports, but to a larger extent abroad. The outstanding subject of interest in connection with naval works was the Admiralty proposal for the construction of a great naval base and dockyard at Singapore, and the decision of the Government to proceed with this work.

British Inland Waterways.—A further section of the River Trent Navigation improvement between Newark and Nottingham, which has been in progress for about two years, became available when the Stoke Bardolph lock was opened by the Minister of Labour in October. These works of improvement, which will cost about £200,000, will enable 120-ton barges to proceed as far as Nottingham at all seasons of the year. The works are of particular interest as being the only inland navigation improvement of any magnitude executed in this country for some years past.

Facilities for Oil Trade.—One of the most significant features in the development of port work, both at home and abroad, since the war, is to be seen in the great increase in the provision made in one form or another for the oil trade. At the present time ports of second and even third-rate importance are making provision for oil storage and oil bunkering. At Grangemouth a jetty for the accommodation of tankers was completed during the year, and a large installation of oil tanks was completed in connection with the importation of crude oil. A new oil fuel installation is being provided at Kynochstown near Canvey Island on the Essex bank of the Thames. The Mersey Docks and Harbour Board's oil depôt at the Dingle Point above the Herculaneum Dock is now in use. Messrs. Cory Bros., of Cardiff, are establishing oil bunkering facilities at many of their coaling depôts abroad on the principal steamship routes, and at Swansea the Anglo-Persian Oil Company has further extended its import and export plant.

European and Foreign Ports.

Europe.—The construction of the Rove Tunnel on the canal from Marseilles to the Rhone is expected to be completed during 1924.

The new harbour of Berlin, which provides accommodation for barges and sea-going vessels of up to 600 tons, was opened for traffic in September. It was reported early in the year that the French firm of Schneider and Co. had secured the contract for the construction of a new river port on the Danube at Budapest. The same firm, in conjunction with other French companies, is also stated to have secured the contract for the new harbour works at the Piræus.

In contrast with activity in the improvement of inland navigations generally in Europe it is reported that the Italian Government has abandoned the scheme for the improvement of the river Po navigation and the project for linking Milan with the sea, work on both of which schemes had already been begun. The Palermo Harbour improvement scheme, which is estimated to cost about £2,000,000, has been started.

South Africa.—The Congella dry dock at Durban, which will be one of the largest in the world, is now more than half built, and the erection of the sliding caissons for the two entrances was begun during the year. There is much activity in the Cape ports in connection with the provision of plant for the export of grain. It is expected that the system of elevators which is now being installed by the Government will enable a large proportion of the next maize crop to be handled in bulk. The new port elevator at Cape Town has a capacity of 30,000 tons.

The reports of Sir George Buchanan on the South African harbours and the proposed new harbour in Zululand, were considered by the Union Government, but no steps which will give effect to any of his recommendations were taken. Negotiations are in progress between the Union Government and the Government of Portuguese East Africa, with the object of improving the facilities for transit through the Port of Lorenzo Marques.

China and Japan.—The great earthquake of September, 1923, which devastated Tokio and Yokohama, resulted in vast damage to the harbour works at the latter place. The Japanese authorities have decided to rebuild the harbour, and already a considerable amount of work has been effected which will enable the port of Yokohama to be used pending complete reconstruction. The naval dockyard at Asano suffered severely as the result of the earthquake.

The report of Sir Maurice Fitzmaurice on the improvement of Hong Kong Harbour was issued in May. He recommends the adoption of an extensive programme of works, the first section of which is estimated to cost over one and a-quarter million pounds. Incidentally, Sir Maurice advises the provision of a depth of 37ft. alongside the wharves at low water in view of the deepening of the Suez Canal in the near future to admit ships of 35ft. draught to pass through it.

India and the Middle East.—Work is still in progress on the Back Bay reclamation at Bombay. It is reported that some modification of the original scheme of work is in contemplation. According to the original plan it was proposed to dredge on the harbour or east side of the Colaba Peninsula, and to pump the dredged material to the site of the reclamation on the other side. It is now proposed to dredge on the west side and to pump over the new embankment on to the reclamation area.

The new cotton depôt which the Bombay Port Trust completed at Mazagon was opened by the Governor of Bombay in March. This work, which had been in hand for about 2½ years, has cost over £1,100,000. Its completion will relieve the congestion at Colaba, which has been a matter of anxiety to the authorities for many years.

Good progress was made with the construction of the King George Dock at Calcutta.

An important work in the Far East which, although not directly connected with dock or harbour undertakings, is of interest to port engineers, was opened for service in October. It is the Johore Causeway, which connects the island of Singapore with the mainland of Johore in the Malay Peninsula. The work was begun in 1919, and, although all of it is not yet completed, railway connection between the island and the mainland is now effective. A traffic lock, which is spanned by a swing bridge, is placed in the Causeway for the use of small craft navigating the narrow strait. The cost of this work is stated to have been approximately £2,000,000.

In the Malay States the most important port work at present in hand is the construction of wharves at Prai, which are now practically completed.

Canada.—The outstanding feature of port development in Canada during the year was the extraordinary attention paid to the facilities for grain shipment at the principal ports. Not only does this remark apply to the St. Lawrence ports, but Vancouver is rapidly becoming one of the most important grain-exporting centres. The storage capacity for grain is being rapidly increased, and it is expected that there will be storage for 3½ million bushels as soon as a large elevator, now under construction, is completed. At Montreal the storage capacity for grain now reaches 9 million bushels, which it is expected will be increased by 2 million bushels during the year 1924. Extensions of grain handling facilities are also to be undertaken at Halifax. Big developments of grain handling facilities are also to be carried out at Fort William, Ontario and Port Arthur.

The new Ballantyne pier at Vancouver, which has been under construction for a considerable time, and has cost approximately £1,250,000, was opened in October.

The new graving dock at St. Johns, New Brunswick, which is one of the largest in the world, was completed, and is stated to be now in use. The entrance is 125ft. in width.

Work is still in progress on the Welland Canal, which, judging by the Government Budget apportionments, is absorbing something over 11 million dollars per annum in construction costs. It will be several years before this great work is completed.

At Esquimalt, Victoria, British Columbia, work was resumed early in the year on the construction of the dry dock after having been suspended by order of the Minister of Public Works. Some delay was caused to the progress of the work early in the year by the bursting of a cofferdam. It is expected that the Dry Dock will be completed this year. The Esquimalt Dock will have an entrance width of 125ft. at the sill level, and a depth of water over the sill of 40ft.

United States.—The New Orleans Navigation Canal was completed and was opened for use in May. It cost about 4½ million pounds and is 5½ miles long. As a navigation canal it will ultimately form an important link between the Mississippi and New Orleans and the sea, but in the main its construction was brought about by the desire to provide increased waterside frontage at the Port of New Orleans.

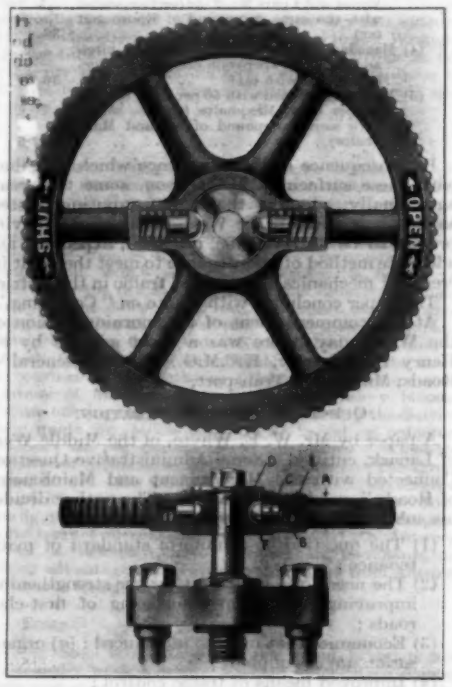
South America.—The contract for the extension of the Valparaiso Harbour works was let to Messrs. S. Pearson and Son, who were responsible for the construction of the earlier works completed about two years ago. The extension of the breakwater involves the building of a breakwater extension 700 m. in length, part of which will be founded at the extraordinary depth of 180ft. below water level. The estimated cost of the section of works now put in hand is £1,500,000.

At Pernambuco the Brazilian Government is about to spend a sum estimated at about half a million pounds on the improvement of the harbour approaches.

At Callao, in Peru, port extensions on a large scale are in contemplation, and at Boca de Ceniza and Magdalena River, in Colombia, harbour works costing £1,200,000 are in course of execution.

Safety Hand Wheel for Valves.

In order to prevent damage to valve spindles and seatings caused by the application of excessive force in the action of closing, a new, simple and ingenious type of hand wheel has been invented by Mr. T. F. Gray, of Bolton's Superheater and Pipe Works, Limited, Adswood, Stockport. In outward appearance, the wheel differs only slightly from an ordinary hand wheel, but it is provided with a friction disc D, which is keyed to the valve spindle and is made of hard steel. On the periphery of this disc are two hemispherical recesses, into which fit the heads of two hardened rustless steel plungers or clutch members C,



THE GRAY SAFETY HAND WHEEL FOR VALVES.

the plungers being held in engagement by means of helical springs E. These springs are made of sufficient strength to keep the plungers in engagement with their holes under normal conditions of operation, but should extraordinary force be applied to the hand wheel after the valve is closed, as frequently happens when bars or levers are used, the plungers are forced out of their recesses in the disc and the whole wheel turns freely, thus preventing damage, such as breakage of the spindle, stripping of the thread or injury to the valve seating. The "Gray" hand wheels are made up to 28in. in diameter and possess the advantage of being applicable to existing or new valves of all descriptions, without any alteration to the valves.

A HEAVY TRAIN.—In connection with a paragraph under this heading, which appeared on page 52 of our last issue, it is only fair to say that the engine, of 134 long tons, which hauled a train weighing, in all, engine included, 1956 short tons, was a Garratt engine by Beyer, Peacock and Co., Limited.

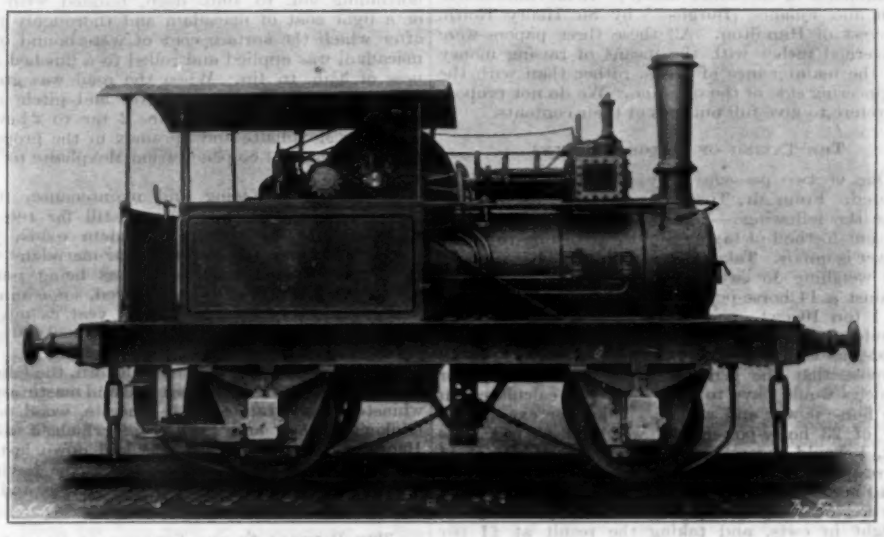
A Chain-driven Locomotive.

THE rather unusual type of locomotive, specially designed for shunting purposes or service on private lines, which is illustrated by the engraving below, is manufactured by J. and H. McLaren, Limited, of Leeds, and, as will be readily appreciated, is an adaptation of the traction engine for which that firm is so well known.

The use of a geared engine naturally results in a very powerful tractive effort being produced by an engine with cylinders small in comparison with those of a normal locomotive, while the arrangement has the advantage that all the principal working parts are easily accessible.

It might be thought at first sight that trouble would be caused through the rise and fall of the driving wheels, as the engine ran over inequalities of the road, altering the tension of the chain, but the makers assure us that they have experienced no difficulty from this cause. A jockey wheel, it will be noticed, is used to take up the slack of the chain.

The engine, illustrated in the engraving, is built for the standard 4ft. 8½in. gauge, and has compound cylinders, 6½in. and 10½in. diameter by 12in. stroke. The driving wheels are 3ft. 1in. diameter. The engine can be fitted



McLAREN CHAIN-DRIVEN LOCOMOTIVE.

with one or more travelling speeds, which can be put out of gear, and the fly-wheel run round for driving stationary machinery. A large water tank is carried in the frame, under the barrel of the boiler, and the engine is fitted with a feed pump and injector.

An engine similar to the one illustrated is at work for general shunting purposes in a Croydon yard, and the owners state that the average load consists of fourteen 10-ton loaded trucks on the level or five trucks up an incline of 3 in 100, the speed being from 5 to 8 miles per hour. The consumption of fuel is about 2 cwt. of Welsh coal per day.

A smaller engine, built for a 2ft. gauge, has a hauling capacity of 100 tons on the level, and is capable of running 15 miles per hour. Compound cylinders are provided, the sizes being 4½in. and 7½in. by 8½in. stroke. The engine is fitted with two travelling speeds, a pump and injector. The driving wheels of this engine are 24in. in diameter. The arrangement of the chain is slightly different, three jockey wheels being employed, so that the chain leads in a horizontal direction towards the driving axles on both the taut and slack sides.

The Quarterly Shipbuilding Returns

LLOYD'S REGISTER shipbuilding returns for the quarter ended December 31st show that the tonnage under construction in Great Britain and Ireland—1,395,181 tons—was about 124,000 tons more than at the end of September, but there was still a decrease as compared with twelve months ago of about 73,000 tons. The total included 164,000 tons on which work is suspended. Deducting this tonnage in order to enable a comparison to be made with figures for normal times, it will be seen that the tonnage actually under construction at the end of December amounted to 1,231,000 tons. The average tonnage being built during the twelve months immediately preceding the war was 1,890,000 tons, *i.e.*, 659,000 tons more than the present total. A considerable increase is, however, shown in the tonnage commenced during the quarter, namely, 244,506 tons, as compared with 111,860 tons during the third quarter of the year. The tonnage launched during the quarter ended September 30th only amounted to 66,474 tons, whereas the total for the quarter under consideration reached 114,583 tons.

The total merchant tonnage being built in other countries—1,049,155 tons—includes about 67,000 tons on which work has been suspended, leaving about 982,000 tons actually under construction, the latter figure being 42,000 tons less than at the end of September, 1923. The figures for the leading countries abroad are:—Germany and Danzig, 336,624 tons; Italy, 119,663 tons; Holland, 112,811 tons; France, 110,725 tons; and United States, 91,585 tons.

From a table showing the number and tonnage of vessels launched and of vessels commenced in the world during the quarter under review, we notice that 217,410 tons were launched abroad and 228,072 tons were commenced. The latter total is considerably larger than for the previous quarter, and in conjunction with the increase recorded in British yards, appears to show a tendency towards an improvement in the conditions of the shipbuilding industry of the world. The total world tonnage—2,444,336 tons—includes 231,000 tons—of which only 67,000 tons are outside Great Britain and Ireland—on which work is suspended. The tonnage actually under construction is thus 2,213,000 tons, which total is 1,233,000 tons below the highest pre-war record reached on June 30th, 1913, viz., 3,446,558 tons.

There are at the present time under construction in the world thirty-one vessels of between 10,000 and 20,000 tons each and seven of 20,000 tons and upwards. Nineteen out of the thirty-one, and all the larger vessels, are being built in Great Britain and Ireland. The returns show that there are at the present time thirty-three steamers and motor vessels, each of over 1000 tons, with a total tonnage of 175,164 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, thirteen of 83,646 tons are under construction in Great Britain and Ireland. The tonnage of vessels now being built in the world which are to be fitted with internal combustion engines amounts to 634,027 tons, while the tonnage of steam vessels under construction is 1,793,579 tons. The motor tonnage thus equals 35½ per cent. of the steam tonnage, showing the remarkable development which is taking place in the adoption of this system of propulsion. These figures include fifty-five motor vessels, each of 5000 tons and upwards, seven of which are of between 15,000 and 22,000 tons.

Of the vessels given in the Returns as being under construction in the world—which total excludes vessels the construction of which has not actually been commenced and also all vessels of less than 100 tons—387, of 1,360,067 tons, are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book.

Australian Engineering Notes.

THE North Australian Worsted and Woollen Company, Limited, now being formed in Brisbane, proposes to erect in the Queensland capital a woollen mill at a cost, when fully equipped, of between £80,000 and £100,000. Later it is probable that mills will be erected at Rockhampton and Townsville or Charters Towers. It is intended to make all the yarns used.

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THE Under-Secretary of Mines anticipates that the mineral production of New South Wales for 1923 will reach a total value of £14,000,000, and that the coal output for 1923 will be 9,500,000 tons, valued at approximately £8,000,000.

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THE Tasmanian House of Assembly has voted a sum of £31,000 to establish a sub-station at Lake Margaret and erect a transmission line from there to Zeehan, on the west coast, for the purpose of supplying electric power to the Electrolytic Zinc Company's ore treatment works at that place.

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A BLAST-FURNACE blowing engine has recently been completed by Messrs. Thompson and Co., of Castlemaine, Vic. It is said to be the largest reciprocating power unit so far constructed in Australia. It is a cross compound steam engine, and the working steam pressure is 225 lb. per square inch. The maximum speed is 100 revolutions per minute, at which speed the air piston displacement exceeds 60,000 cubic feet per minute. The net floor space occupied by the engine is 25ft. wide by 56ft. long. The engine was designed and constructed to the order of the Hoskins Iron and Steel Company for use at its iron and steel works at Lithgow, N.S.W.

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THE return to prosperous conditions and financial buoyancy in New South Wales is strikingly illustrated by the building statistics of the Metropolis for 1923, which show that new buildings erected numbered 10,450 at a cost, including additions to existing buildings, of £10,133,116.

Scottish Road Conference.

ON Tuesday and Wednesday of this week a "Scottish Road Conference" was held in the City Chambers, Edinburgh. It was held under the auspices of:—The Convention of Royal Burghs; the Association of County Councils; the Association of District Committees; the Institution of Municipal and County Engineers (Scottish District); the Association of Road Surveyors in Scotland; and the Royal Scottish Automobile Club, and was attended by numerous delegates from all parts of Scotland.

On the Tuesday at the morning session the representatives were, first of all, welcomed by the Lord Provost of Edinburgh, and then set themselves to consider the general question of "Road Administration and Finance." The following three papers were presented for discussion:—(*a*) "Road Maintenance and Finance—Scotland," by Mr. J. Harling Turner, the Convener of the County of Ayr; (*b*) "Highway Finance," by Mr. Wallace Fairweather, the Chairman of the Upper Renfrewshire District and Roads Committees, and President of the Association of District Committees in Scotland; and (*c*) "Road Administration and Finance (Burghs)," by Sir Henry Keith, Provost of Hamilton. All these three papers were concerned rather with the means of raising money for the maintenance of roads, rather than with the engineering side of the question. We do not propose therefore to give full outlines of their contents.

THE TAXING OF MOTOR VEHICLES.

One or two passages may, however, usefully be quoted. From Mr. Turner's paper, for instance, we take the following:—"I . . . suggest that the present method of taxing motors according to horse-power is unfair. Take, for example, a 23 horse-power car weighing 15 cwt., and which is taxed at £23, against a 14 horse-power car weighing 1 ton 5 cwt. to 1 ton 10 cwt., and taxed at £14, and which, I should say, nearly doubles the wear and tear to the roads, as compared with the lighter car. I would propose that the general licence which all motor vehicles would have to bear should be calculated on the horse-power and weight. Take, for example, a car of 23 horse-power and weighing 15 cwt., the tax, I would suggest, would be £3 9s.; a car of 14 horse-power and weighing 30 cwt., £4 4s.; and a car of 40 horse-power weighing 40 cwt., £16. These rates are arrived at by multiplying the horse-power by the weight in cwts. and taking the result at £1 per 100 cwt.-h.p."

GRANTS FROM NATIONAL SOURCES.

Mr. Fairweather summarised his remarks as follows:—"A higher standard of maintenance of main roads is desirable, and to secure that and fair upkeep of other roads, larger grants are required from national sources, approximating to half the total cost. The fund to provide such grants should be enlarged by higher taxation of the heavier users of the roads. The balance of cost can best be met by local rating on the basis of valuation as at present, excepting in cases of exceptionally low valuation where trunk roads pass through the area. Uniformity of standard should be secured if need be by supervision of road engineers appointed by the National Contributing Authority."

In concluding his paper, Sir Henry Keith remarked:—"But when we observe that the expenditure upon roads has increased from £17,900,000 in 1913 to £41,500,000 in 1921, we have to admit that the cause of the increase is 'mechanically propelled vehicles,' and to inquire whether their contribution to the cost is reasonable. It is certainly not equitable that the greater portion of the increase should be borne by local ratepayers with limited resources for what is, undoubtedly, mainly national service. But neither of the alternatives seems to afford a permanent solution. Luxury motors should certainly pay sufficiently for the comfort of smooth roads. Commercial motors can only contribute adequately by levying a form of indirect taxation upon their customers; although all forms of heavy motors, involving excessive wear of roads, should be specially taxed. But just as I should maintain that all national and quasi-national services should be financed by a graduated single tax upon incomes above the poverty level, so I hold that roads, except so far as they are financed from motor licence duties and charges upon direct users, should be classed among the national services. Rating as we know it should be abolished, except for services beneficial exclusively to property, and thus the burden of national service would rest on the units of the State in proportion to their ability."

THE MAKING AND MAINTENANCE OF ROADS IN CITIES.

At the afternoon session the first paper on the list was contributed by Mr. John R. Findlay, City Road Surveyor of Edinburgh. It was entitled "The Maintenance of Roads in a Large City," and it dealt specially with road widenings and road surfacings, carried out and used, respectively, in Edinburgh. The author stated that during the past two years from 400 to 500 men had been employed by direct labour on road work, and that the schemes of road widening and improvement completed, in hand, or about to be begun entailed a gross expenditure of £416,893. The cost per mile varied considerably, depending on the amount of cutting, rockwork, wall and bridge building, and compensation to owners and tenants, but the larger schemes averaged £30,000 per mile. All the roads were finished with stone boundary walls or iron fencing, and the following are some of the prices paid for materials, &c.:—

Rubble walling, average 14in. thick	13s. per yard
" "	26s. per cubic yd.
Iron fencing, 5ft. high (balusters ¾in. thick)	13s. 6d. per lin. yd.
Whinstone rubble for bottoming, including cartage	6s. to 6s. 6d. per ton
2½in. dry macadam, including cartage	9s. 6d. to 11s. per ton
Tarred aggregate (¾in. to 2½in.), including cartage	24s. to 26s. per ton
Tarred ¼in. to ¾in. gravel for footpaths, including cartage	28s. to 29s. per ton
Jobbing carts, per pair	24s. to 25s. per day
Granolithic pavements, including 6in. bottom, 2in. 6 to 1 binding, and 1in. of 2½ to 1 finishing coat	6s. 7d. per yard
10in. by 6in. hammer dressed curb	1s. 6d. per lin. foot
Three-course 4in. by 6in. whin sett channels	2s. per lin. foot

The roads generally were constructed with whinstone bottoming 9in. to 10in. deep, blinded with ashes or a light coat of macadam and thoroughly rolled, after which the surface coat of waterbound or tar-macadam was applied and rolled to a finished thickness of 3½in. to 4in. When the road was grouted, the mixture used was either tar and pitch, in the proportion of a barrel of No. 2 tar to 2¼ cwt. of pitch, or Mexphalte and Spramex in the proportion of about 2 cwt. of 65 penetration Mexphalte to 1 cwt. of Spramex.

As regards surfacing and maintenance, it was mentioned that while there was still far too great a mileage of waterbound macadam roads, yet a policy of converting them to tar-macadam whenever renewals were necessary was being pursued. All tar-macadam roads were sprayed, some annually, and others every second or third year as might be required. At present an area of about 850,000 square yards was sprayed annually in Edinburgh.

Mr. Findlay finally discussed, in turn, the following surfacing materials:—Compressed and mastic asphalt, whinstone and granite setts, concrete, wood paving, clinker asphalt, and rubber, of which a section, 100ft. long by 16ft. wide, was laid down last year in one of the main thoroughfares. The paving, it was explained, had an excellent surface and had, so far, stood the traffic well.

THE PAVINGS OF THE STREETS OF GLASGOW.

A second paper, also entitled "The Maintenance of Roads in a Large City," was by Mr. Thomas Somers, Assistant Master of Works, Glasgow, and dealt with street paving in that city.

It appears that out of a total length of 345 miles of public streets, 117 miles are surfaced with macadam, 198 with setts, 23 with asphalt, 6 with tar-macadam, and only 1 with wood. The small amount of wood was explained by the fact that it was found very costly to maintain owing, largely, to climatic conditions and to the method of shoeing horses which is employed. Where necessary, and where gradients permitted, the ordinary macadam road was, Mr. Somers said, being re-surfaced with tarred metal, the interstices being filled in with granite chippings. After rolling, the surface was tar-sprayed, gritted with granite chippings, and lightly rolled. During the last two summers a mixture of tar and bitumen had, continued the author, been used for spraying and coating metal for the repair of concrete roads.

With a view to getting information as to the wearing qualities of various paving setts under the traffic conditions in the city, a street was, some years ago, laid down in sections with whin and granite setts from quarries throughout the country. As a result of that test, which extended over a period of years, it was found that the best wearing setts were of Scottish granite from West Coast quarries in the neighbourhoods of Loch Fyne and Loch Etive, namely, Furnace and Bonawe, and Welsh granite from Penmaenmawr. The life of granite-sett paving in Glasgow is from twenty-five to thirty years.

In discussing "Maintenance" in a final note in his paper, Mr. Somers remarked: "The continued opening of streets by Corporation Departments and Post Office authorities for the purpose of laying services, materially adds to the cost of maintenance of the streets. There is no doubt that the life of street paving, in many cases, is very materially reduced by such openings. No restoration of such openings is satisfactory, but while every endeavour is made to prevent such openings being made by asking the Departments if they have any works to carry out before proceeding with the paving of streets, it would appear to be inevitable that openings are required before the paving is ready for renewal." Glasgow is not the only city which suffers from this cause!

REPAIRING AND MAINTAINING ROADS IN SCOTLAND.

The third paper, which was by Mr. W. L. Gibson, M. Inst. C.E., Road Surveyor to the Perthshire County Council (Western District), was entitled "Methods of Repair and Maintenance of Roads in Scotland."

Mr. Gibson remarked that a system of road construction which might give excellent results in England might be a decided failure in Scotland, because the former country was favoured with much better weather conditions than was the latter. He gave the following statistics as to the average weather conditions which prevailed in the Midlands of Scotland last year:—

Rainfall	49in.
Rain days	218
Sunshine	1385 hours
Frost	Variable during winter months
Snow	25 days
Average day temperature	57.7 deg. F., summer
" " "	39.8 deg. F., winter

These figures, he said, gave some idea of the adverse conditions which confronted the engineer who was responsible for road maintenance. He had also, he added, to reckon with sudden changes in temperature and weather conditions, which had very serious influences on the wearing crusts, particularly in the winter months, during sudden thaws after spells of frost. The past season had been one of the very worst in the memory of all in that respect.

The author, after emphasising the necessity of providing a strong, properly drained foundation, no matter what wearing surface was to be put on the top of it, then went on to describe the results obtained from laying a series of experimental surfaces on the Great North Road near Dunblane, in June, 1915. These sections had been under test during the intervening 8½ years, during which approximately 1,000,000 tons of traffic had passed over them. We cannot afford space to refer in detail to the figures which are given as a result of the test, but it may be said at once that they prove amply that ordinary macadam, even when its surface is tarred, was found to be very considerably inferior in length of life and cost of upkeep to tar or bituminous macadam. To use Mr. Gibson's own words, the figures "prove conclusively the false economy of laying a cheap and weak class of construction as compared with a more expensive and stronger kind, on a road which is subjected to a fairly heavy traffic."

During the past four years further tests of various kinds of road construction had, Mr. Gibson went on to explain, been under observation on first-class roads in West Perthshire. Among them were:—

	Cost per square yard. d.
(1) Groutphalte macadam (surface sealed with Sprayphalte)	36.93
(2) Tarred nickel slag aggregate (surface sealed with Spramex)	55.25
(3) Macadam grouted with 2 parts Limmer Epure and 1 part No. 2 tar (surface sealed with the same compound of Epure and tar)	38.49
(4) Macadam grouted with equal parts pitch and tar and 10 per cent. creosote oil (surface sealed with tar)	36.89
(5) Macadam grouted with 50 per cent. tar and 50 per cent. Mexphalte (surface sealed with same compound of tar and Mexphalte)	45.75

In consequence of the experience which he gained with these surfacings, Mr. Gibson, some two years ago, finally adopted the 50/50 grouting system as the most suitable for West Perthshire, it having proved to be an economic, practical, expedient and adequate method of maintenance to meet the great increase of mechanically-propelled traffic in the district.

The paper concluded with a note on "Carpeting."

At the commencement of the morning session on the Wednesday, there was a short address by Sir Henry B. Maybury, K.C.M.G., Director-General of Roads, Ministry of Transport.

QUESTIONS OF ADMINISTRATION.

A paper by Mr. W. E. Whyte, of the Middle Ward of Lanark, entitled "Some Administrative Questions Connected with the Management and Maintenance of Roads," was then presented. The author divided his subject under the following headings:—

(1) The question of a uniform standard of maintenance;
(2) The need for a time limit for the strengthening, improving, and proper surfacing of first-class roads;
(3) Economies that may be introduced: (*a*) organisation, (*b*) use of plant;
(4) Improved means of traffic control;
(5) Direction posts and danger signs;
(6) Future working programme;
(7) Research and experiment;

and concluded by suggesting the formation of a Consultative Council for Scotland, which should represent the various interests, and which should keep itself abreast of the times and fully informed of new and improved methods and systems, explore difficulties, anticipate developments, and act generally in an advisory position.

The Conference closed at mid-day.

AN appeal is being made by the organisations which formed the Traders' Co-ordinating Committee for funds to carry on its work as the Railway Rates Tribunal. This committee endeavours to secure agreement with the railway companies and thus to reduce some of the questions as to standard charges that will have to be decided by the Tribunal.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Situation.

THE cautious spirit which was manifest at the quarterly meeting of the Midland iron trade continues to hold sway, political and labour uncertainties and the menace of foreign competition being mainly responsible. Continental competition has become a factor the influence of which cannot be disguised. While most native prices are advancing, continental quotations are coming down week by week, and Belgian representatives who attended last week's iron trade meeting were ready to do business at prices which have disturbed confidence in the stability of home prices. The price reductions of foreign competitors have effectually prevented any further price advances either in iron or steel. Makers, in fact, find it difficult to maintain recent quotations. There are great complaints of the unprofitable character of steel production, but in spite of the reorganised association, prices cannot be advanced under existing circumstances. In some cases the foreign quotation is as much as £2 5s. per ton below the home figure for the same class of material. Nevertheless, it does not appear that a particularly large volume of business is going abroad even at these prices. Buyers, however, anticipate a reduction in home prices, and they are withholding orders. At the moment both producers and consumers are adopting a waiting policy, and business "hangs fire."

Manufactured Iron.

Although the specifications for the finished iron required in connection with the new wagon building orders have not yet been given out, local ironworks have fairly satisfactory order books. There are indications that iron will be preferred to steel in these contracts, owing to its better resistance to corrosion, and the Staffordshire ironworks are looking forward to a busy time. Up to the present there has been no such accession of new business as would stimulate the upward movement in prices lately apparent. Marked bar prices have, therefore, been left alone. They have stood at £14 10s. since April last. Crown bars are firm. Staffordshire producers are having to pay 1s. per ton more than of late for works' coal, and in some cases 5s. per ton more for pig iron, and, consequently, they now adhere to the basis of £12 10s. Makers of nut and bolt bars are endeavouring to get something more than £11, notwithstanding the disparity between that figure and the price to which Belgian bars have now been cut—about £8 11s., a reduction of some 4s. per ton on recent quotations. It seems more than a coincidence that Belgian quotations should be reduced at a time when home prices are rising. South Staffordshire mills now quote £11 2s. 6d. to £11 5s., and Lancashire mills quote £11 10s. While there is a fair amount of work in hand, additional orders are hard to get. Wrought iron gas tube strip has increased in value by from 2s. 6d. to 5s. per ton. Producers who were doing business at £12 15s. last week are now demanding £12 17s. 6d., and in some cases £13.

Steel.

Steel makers have good order books, but are finding it necessary to handle prices cautiously. For the most part they have to depend upon large production to make a profit, and they get some assistance in this direction by the heavier tonnages now ordered, which reduce the amount of roll-changing. The severe Belgian competition, which is becoming keener, is having its effect upon the raw steel situation, and billet values have been brought down to £8 10s., with sheet bars, in some cases, as low as £8 5s. per ton. Steel makers complain that prices are finely cut. Nevertheless, they find it difficult to maintain even current rates under the stress of continental competition. Belgian sellers are very desirous of finding customers here for heavy blooms, and are offering supplies at £6 10s. delivered in the district. They quote 2in. billets at £7 to £7 2s. 6d., a reduction of about 5s. per ton on recent quotations. While the majority of rollers of small steel bars adhere to the agreed figure of £10 15s., other producers, in face of external competition, have quoted down to as low as £10. Even this figure, however, fails to attract customers with Belgium in the market offering supplies at £7 2s. 6d. f.o.b. Antwerp, or £8 5s. delivered here. Birmingham merchants are taking advantage of this steel to ship direct from Antwerp to various foreign destinations.

Scrap.

Steel scrap, following the recent boom, is now a decidedly weak market. Though sellers have reduced their quotations by something like 15s. per ton, they fail to find customers. Offers have this week been made by sellers at £4 5s. and £4 7s. 6d., but little business is passing.

Galvanised Sheet Values Easing.

Though the sheet mills have still a great deal of work to get through before they will be seriously troubled about further contracts, the quietude in 24 gauge corrugated sheets has resulted in prices easing to the extent of about 5s. per ton. Mills that have not full programmes have this week accepted orders at as low as £18 10s.

Lead-coated and Tinned Sheets.

At the usual meeting last week of the Tinned Sheet Manufacturers' Association, prices were fixed for the ensuing quarter at: Best charcoal, 58s.; charcoal, 56s.; unassorted, 52s. per cwt. to 20 gauge. The new quarter's price for lead-coated sheets is £28 per ton to 20 gauge.

Raw Iron.

Pig iron producers in the Midlands continue their efforts to improve upon late selling prices, though they are not meeting with much success. Values are maintained, however. Furnace owners say that present prices yield only a bare return on the basis of coke at 24s. at ovens; but that rate has only a limited application. About fifteen months ago blast-furnace coke was selling at 17s. 6d. at ovens, but to-day the price is nearer 27s. 6d. This is a prohibitive figure for independent Black Country furnaces, which look to pig iron and pig iron alone to earn them a profit. The loss of keeping furnaces standing is heavy, but owners prefer this course to the more risky one of restarting in the present conditions of the market. Coke supplies are still stringent, and it is no easy matter to secure sufficient to keep going those furnaces which are in blast. The market level for Midland brands would appear at date to be: North Staffordshire forge, between £4 10s. and £4 12s., and foundry, £4 17s. 6d. and £5; Northamptonshire runs, forge, £4 7s. 6d. to £4 8s. 6d., with foundry, £4 13s. 6d. to £4 15s.; Derbyshire makers want £4 8s. to £4 10s. for forge, and £4 15s. to £4 17s. 6d. for No. 3 foundry.

£150,000 Bridge Contracts for Tipton.

Much satisfaction was expressed in Midland engineering circles when it became known that the Horseley Bridge and Engineering Company, Limited, Tipton, Staffordshire, had secured a £150,000 contract, given out by the London and North-Eastern Railway Company, for the erection of bridges to span the river Waveness in Norfolk. The contract is for two steel girder bridges, swinging on a central pier, with long approach viaducts on either side. Powerful electric motors will be used to swing the bridges round parallel with the stream to allow river craft to pass up and down.

Nut and Bolt Industry.

The nut and bolt industry of the Black Country is, I am happy to state, showing considerably more activity than has been the case of recent months, and Darlaston manufacturers generally seem to be of the opinion that further improvement may be looked for during the ensuing year. Mr. George Wiley, of James Wiley and Sons, Limited, in a recent interview, said that for some years the Chinese market had been closed to British bolts and nuts, but lately there had been inquiries for material for Chinese railways, and quotations were being sent out. Special efforts were also being made to capture the small bolt trade which had been held by America for twenty-five years.

The Chain Trade.

There has been a definite improvement in the chain trade in South Staffordshire of late, and although there do not appear to have been any really big contracts booked as yet, the prospects are brighter than they have been. There has been quite an improvement in shipbuilding in the commercial sense, but such ships as have been ordered will not provide immediate work, because the chains, cables and anchors required for them will not be wanted until the boats are ready for launching. There is, however, an improvement in the engineering industry, which affects the chain trade, and which is expected to provide early additional work.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Conditions.

THE iron and steel markets here remain very quiet, and the feeling with regard to the quarterly meeting at Birmingham is one of disappointment. Much more definite movement was expected from this meeting of the trade; but although the general tone was cheerful there was no indication whatever that prices of iron and steel were about to become more profitable to the producers. Hence, in the Manchester market the feeling is rather duller than it was before the quarterly meeting. Nevertheless, it is believed here that a slow and steady improvement in trade is coming as work progresses on the various railway schemes. The announcement of the postponement of Government shipbuilding in view of a possible change is taken rather badly, and the whole political situation is blamed for the failure of the market to respond to the hopeful feeling of the New Year. There seems to be a good deal of nervousness all round, and part of it is in connection with the fear of failure and the utter uncertainty of financial stability.

Metals.

The non-ferrous metal trades in this district are in a doubtful position. Any hope of a revival in copper prices seems now to be abandoned, and a low average price is believed to be probable throughout the first quarter of the year. The only strong section of the market is tin, for which higher prices have been obtainable. Some time ago it was suggested that tin might again reach £250 per ton, and this point seems now to be near at hand, if it be not already arrived at by the time these lines are printed. The statistical position of the metal is very much better than it was at the beginning of last year. Visible stocks have been reduced by a considerable amount; but, on the other hand, the price of tin is some £60 per ton higher than it was last January. The price has, however, been slowly moving upwards ever since last August, and it is by no means certain that the upward movement has yet come to an end. It is thought, however, that there may be some profit-taking which may affect the market for a time. Copper keeps very dull here, and the fluctuations have been inconsiderable. The steady fall in the American Exchange naturally tends to keep up the price in sterling of electrolytic copper. The market is, however, so low that it is difficult to believe in any further fall, although there are no signs of a movement in the other direction. Certainly, the engineering demand for copper is poor, but the cable and copper wire departments are taking a fair quantity of metal. There is no doubt that the lack of money to buy new machinery is hindering any revival of the consumption of copper in the engineering trade. Dealers in old non-ferrous metals may generally be trusted to get a fairly accurate idea of the state of things, and it is noticeable that they are very disinclined to buy for stock and are offering very low prices for old gun-metal and brass, the reason being that they find no adequate outlet for it. In Manchester a good lot of old gun-metal will barely fetch £46 per ton from a dealer. No change has been made in the official prices for manufactured copper and brass. Lead and spelter have both been very steady markets of late, and the latter metal seems inclined to rise. Lead is a little uncertain owing to the disturbances in Mexico, which may lead to some curtailment in the supply.

Pig Iron.

The market here for foundry pig iron remains very quiet, and there is now no indication of higher prices to come. The threat of a great railway strike has caused considerable anxiety, for if it comes it cannot pass without causing great dislocation of trade and great losses. With this threat hanging over industry it is, of course, impossible for a revival of trade to develop as it might otherwise do, and both buyers and sellers of pig iron are more cautious. The price for Derbyshire foundry iron, delivered in Manchester, remains at about 102s. 6d., with Lincolnshire at 104s.; but there is less inclination to buy for forward delivery. It seems quite possible that for a month or two buying will be confined to small lots. There is still great uncertainty as to what may happen to coke prices. At present the theoretical price of furnace coke in the Midlands is 24s., but ironmasters are reckoning that they will have to pay 25s. shortly, and perhaps 26s., and then the present selling price for pig iron will scarcely pay. There is, however, no great chance of raising the price even if coke should become dearer. The export demand for pig iron remains poor, but this concerns Cleveland furnaces more than those upon which the Manchester foundry trade relies. Prices for Scotch and for hematite pig iron in Manchester remain steady, but there is not much business being done.

Steel.

There has been rather more inquiry reported lately for steel plates, but not very much actual business has been done. Some makers keep to £11 per ton, but business can be done at £10 10s. to £10 15s. There are merchants with stocks bought before the recent advances who could do better than this. The demand for sections is dull, and selling agents complain that they cannot easily obtain the Association price of £10 per ton; but in view of the general position one cannot think that this price is too high, or that anything would be gained by reducing it. There is no margin of profit for the makers at £10 per ton. Continental prices, both for finished steel and for iron, have been easier, and it is possible that competition from that source of supply may become greater. At any rate, there is now no chance of imports being stopped by legislation.

Scrap.

Dealers in scrap iron and steel are still rather discontented with the state of their trade. There has, however, been some improvement in the demand for melting steel scrap from Sheffield, and it is possible that business with Lancashire will be resumed. Sheffield consumers are prepared to pay 5s. per ton more than was the case at the opening of the year, and it is said that supplies are now scarce in that district. The prices offered by Welsh consumers are useless to the Lancashire dealer. Heavy wrought scrap is fairly firm and up to 100s. is still paid by some of the Lancashire forges. In cast scrap not much is being done here yet. The nominal prices quoted by dealers are unaltered, and range from 87s. 6d. to 95s. per ton according to quality. Ironfounders have not yet begun to buy in any quantity, but it is believed that they must soon come into the market.

Tidal Intakes for Power Stations.

A paper on "Tidal Intakes for Power Stations" was read before the Liverpool Engineering Society on the 9th inst. by Mr. T. R. Wilton, M. Inst. C.E. The author said that there was a natural tendency in this country for a large section of its industries to be developed in areas on the seaboard, and that therefore power stations adjacent to the seaboard were favourably placed for distribution purposes. A further advantage was in connection with the disposal of ashes, which, in some cases, could be combined with the reclamation of low-lying or slob lands on an estuary or sea frontage, or they could be disposed of by dumping in the adjacent waters. He mentioned several difficulties which had to be overcome in the supply of condensing water from tidal sources, namely, the alteration of the level of the source of supply, the presence of solids—both floating and in suspension—the preservation or creation of suitable local littoral or estuarial conditions, and the protection of the source of supply from damage by shipping. Mr. Wilton described an intake system for condensing water which he had designed for the United Alkali Company at Widnes. These intakes were designed with a very low velocity at the mouth, the water being speeded up afterwards to prevent deposition. The pumps were self-flooding, and a syphonic recovery of head was arranged at the outlet. The mouths of the intakes were in extraordinarily shallow water, and there were abnormal sand and mud troubles with a great tidal range. As a safeguard against possible shoaling at the mouths, or deposition of mud in the intakes, the latter were arranged so that flushing could be employed. An area on the site was left sufficient to accommodate a large flushing pond, but it was not constructed, as it was hoped that the special precautions adopted in the design would render very little flushing necessary. Only a couple of old boiler shells were installed as flush tanks, and they had proved very ample for the work, and despite the very adverse local conditions the system had given practically no trouble.

Laboratory for Colloid Research.

The new colloid laboratory at the Manchester University is to be formally opened on January 23rd. It comprises a series of rooms equipped with all the necessary appliances, which have been provided by subscriptions raised by a committee under the chairmanship of Mr. Kenneth Lee. The primary object has been to found a laboratory for pure research in colloids, but the promoters believe that the results of such research work will have a beneficent influence on the applications of colloids in commerce.

The State of Trade in Lancashire.

The slight, but decided, improvement in the engineering trade of South Lancashire, which set in towards the end of last year, promised well for a time, and there was a general expression of satisfaction with the outlook. Since then, however, political affairs, coupled with threats of labour troubles in the coal mines and on the railways, have had a tendency to weaken these confident anticipations at a very unfortunate period. As a result, many contracts which would otherwise have been placed by now have been held up awaiting developments. As regards the coal disagreement, there is a feeling that in some parts of the country the rates of pay are at present inadequate, and are capable of adjustment on a basis which will be found satisfactory to all concerned. I do not find, on the other hand, very much sympathy expressed for the locomotive drivers, and there is a feeling that a settlement of this trouble will be effected. What Lancashire wants, above everything at present, is an improvement in the textile industries. The abandonment of the short-time movement early in December seemed to indicate a revival in trade, but it was effectively stopped by a considerable rise in the price of cotton, which reduced business to a very small quantity. When the cotton trade begins to improve, everything else in this part of the country must follow suit. There will, however, be no real betterment until there is a fall in the price of the raw material.

BARROW-IN-FURNESS.

Hematite.

Whether it be that the holidays have interfered with business, or that the political outlook is somewhat disturbing, the hematite pig iron trade is not improving as fast as one was inclined to hope. There is certainly a better feeling existing, and the market is inclined to be more confident, yet the business done up to the present has not been what one expected it would be. It may be that the next few weeks will bring a better demand, for it is pretty well known that the requirements of the various customers in the several districts are much increased by recent orders. Scotland has not improved as there were hopes that it would do, but now that the holidays are over and now that the customers realise that the prices are firm—with an inclination to rise, if anything—they will place orders. The Midlands are taking a better supply, and this demand will steadily increase, for their commitments are heavier than they have been for some time. There is a better trade with North Wales, several cargoes going to Connahs Quay last week. This is a regular trade. The continental trade is only moderate, and only part cargoes are going. One left last week for Antwerp.

Iron Ore.

The iron ore trade is dull, and there is not much chance of improvement until the demand for iron is better and more furnaces are in blast. The trade in local ore out of the district does not bulk largely. The amount of business done in foreign ore is small, and the number of ships arriving is few. There was an arrival from Calcutta last week of a cargo of manganese ore.

Steel.

The steel trade still promises better, and small orders are still in the market. The prospects this year are certainly better than in January last year. The Barrow rail mills are engaged and are likely to be for some weeks on present orders, and it is more than likely that fresh orders will be forthcoming very soon. In Cumberland the Moss Bay rail mills will soon be at work, and their prospects are also better. The foundries are experiencing slightly better business, and the hoop and section mills are well circumstanced. A cargo of billets arrived at Barrow last week from Ghent.

Shipbuilding and Engineering.

There was dispatched a part cargo of machinery from Vickers, Limited, at Barrow, for India, the port of discharge being Karachi.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trade.

THE prospects of the steel trade continue favourable, and the tonnage turned out by the heavy furnaces is increasing. The flow of new business this week has been less marked, but it is hoped that that does not indicate any deep-seated alteration in the situation. The political and labour outlook, and the fall in the value of the franc, are suggested as probable causes. New open-hearth furnaces have been put into commission during the past few weeks at more than one of the big local works. The railway departments continue to book work, and, although it is not coming in with any rush, the axle, tire and spring plants have enough on hand to keep them employed for several weeks. The spring makers are particularly busy, and are running full time to turn out large quantities of both the laminated and spiral kinds. The buffer-making shops also have a considerable amount of work on hand. The building of locomotives is sending a good number of orders to the steel foundries for castings. Some improvement is noted in general engineering.

The Lighter Side.

Very satisfactory progress has been reported in the finished steel trades since the new year started. The number of crucible steel furnaces in operation is still far below what it should be, but a few others have been brought into use lately. While some firms are emerging but slowly from the slump, there are others which are managing to work five days a week. Some of the makers of tools used in excavation, quarrying, engineers' shops and shipyards have a full amount of work, and there is a much improved call for files. For farm and garden tools the season has opened very well, and practically full employment is the rule at the factories concerned.

Steel Exports to America.

In spite of the Fordney Tariff, America has to go on buying Sheffield steel, and while the figures show, on the face of them, a falling off, explanations are possible which make one wonder whether the tariff is not, after all, hitting the people of the United States most. Thus, while the value of the steel material exported from Sheffield to the States in 1923 was only 1,897,701 dollars, as compared with 2,373,248 dollars in 1922, it has to be remembered that the reduction was experienced, chiefly, during the first months of the tariff, and against this is to be set the fact that exports had been on a larger scale than usual during the previous months, in anticipation of the tariff. Most of the lost ground was recovered during the latter half of last year, and the exports are now nearly equal to the former standard. The exports of cutlery to the United States showed a considerable falling off last year, the total value being 136,263 dollars, as compared with 221,685 in 1922.

Cutlery and Plate.

There is nothing very satisfactory to report about the cutlery trade, in which orders are keenly competed for and unevenly distributed. Many of the smaller manufacturers are doing a large bulk of trade, but the ratio of profit is very low. The chief feature of the trade is still the demand for stainless table knives. These are in great demand, and large orders continue to come forward from hotel and café proprietors, shippers and store traders and auctioneers. In the silver and electro-plate trade a few firms are well employed on orders from large catering houses, and the prospects of orders for shipping outfits are better than they were last year. The spoon and fork department continues well employed, but for hollow-ware and luxury articles generally the demand is poor.

Some Good Orders.

A few good orders, which will benefit local firms in their branches, both at Sheffield and elsewhere, are reported. John Brown and Co. have secured a contract from the Canadian Pacific Railway Company for the building of two passenger steamers of approximately 5000 tons each and fitted with all the latest modern improvements. These vessels are for the British Columbia coastal service, and will operate between Vancouver, Victoria and Seattle. They will have accommodation for 325 passengers, and will cost in the neighbourhood of £300,000 each. They are to be ready for service by the spring of 1925. It is stated that this order will bring the amount spent by the Canadian Pacific on the Clyde to over £21,000,000. Another order which Vickers have booked—in this case for their Barrow works—is for two marine heavy oil engines of 500 horse-power, which are to built for a Japanese firm as duplicates of an engine recently delivered to another firm in that country. The engines are to be of the four-stroke crosshead type, with six cylinders. Another Yorkshire order reported is one gained by John Butler and Co., Limited, of the Stanningley Ironworks, Leeds, for the steel work required in the widening of the railway approach to the Wellington Station, Leeds, of the London, Midland and Scottish Railway; and also for bridges at Skipton and at Horbury Junction, near Wakefield.

Visit of Chinese Mission.

Sheffield has been visited this week by the Chinese Commercial Mission, which is charged with the task of investigating the industrial conditions of Europe, America and Japan, and is headed by Mr. Chang Chien, jun., Minister Plenipotentiary and High Commissioner of the Republic of China. The members of the Mission spent two busy days in Sheffield. They were entertained to dinner by the Chamber of Commerce, and paid visits to the works of Vickers, Limited, Edgar Allen and Co., Limited, Arthur Balfour and Co., Limited, the Hardy Patent Pick Company, Limited, Walker and Hall, Limited, and Hadfields, Limited. It was regretted that the time at their disposal did not permit of their visiting any of the very finely equipped collieries of the district.

Sinking at Brodsworth Main.

The latest instance of colliery development is at Brodsworth Main, one of the largest pits in the Doncaster district, where sinking to the Parkgate bed is now in operation. A third shaft is being put down, and the winding engine for it has just been completed. When the sinking is completed, and both the Barnsley and Parkgate seams are in full work, it is estimated that the pit will be able to "turn" approximately 40,000 tons per week. At present, with two shafts working, the output averages about 30,000 tons weekly.

Various Local Schemes.

The West Riding County Council has decided to carry out a widening of the Bawtry and Tinsley road at Maltby. The Council also has before it a scheme for the reconstruction of Thorne toll bridge, at a cost of £21,000, subject to the Ministry of Transport contributing £11,790, and the Sheffield and South Yorkshire Navigation Company £2860. The Derbyshire County Council is proposing to spend £82,000 in the improvement or reconstruction of ten important bridges at Killamarsh, Baslow, Rowsley and Burton-on-Trent.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE general trade position in the North of England has assumed a very quiet appearance this week in consequence of many disturbing factors at home and abroad. The uncertainty of the political outlook, and fears with regard to a railway strike, incline business men to caution, but a still more serious disturbance, especially in the iron and steel trades, has been caused by the fall of the franc, which gives what is a very real if only temporary advantage to French and Belgian producers. No doubt costs will ultimately be adjusted to the altered values of the franc, but for the moment France is enjoying all the advantages and none of the penalties of inflation. Her manufacturers are able to undersell the British, not only in foreign markets, but also in our own.

Cleveland Iron Trade.

The renewal of foreign competition is being severely felt in the Cleveland iron trade. In Scotland good French foundry iron is being landed at 10s. per ton cheaper than Cleveland can be delivered, and even in this district several steel works are reported to have bought continental basic iron at fully 10s. per ton less than the local product. Thus Cleveland producers have been cut out of the continental markets, and even in Scotland they are losing grip. Of course, there is still a substantial home consumption to meet, and the outlook is not wholly black, but without foreign trade it is improbable that the number of furnaces now working could be kept in operation, and it seems likely that prices will have to fall in order to stimulate the demand for iron. The present inclination of buyers is to hold off, and as many of the works are bought well ahead they are in a position to do so. The market is certainly weaker, and although some makers still quote 100s. for No. 3 G.M.B. Cleveland pig iron, purchases are possible at 99s. per ton.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade is fairly satisfactory. Makers adhere to a quotation of 102s. 6d. per ton for mixed numbers, and 103s. 6d. for No. 1, but a definite offer of business at 6d. per ton less would probably not be turned down.

Ironmaking Materials.

A fall in ore prices has stimulated interest, and there is rather more inquiry. Freights are still high, but best Rubio ore is offered at 24s. per ton c.i.f. Tees. Good medium furnace coke ranges from 36s. to 37s. per ton delivered at the works.

Manufactured Iron and Steel.

There is a lull in the manufactured iron and steel trade. Here again there is a good deal of foreign competition. Cheap Belgian billets are being sold in considerable quantities, and there are also offers of French steel plates at prices with which home producers cannot compete. It is understood, however, that only small quantities of the latter are available, and there is some uncertainty regarding delivery. Steel prices are all unchanged.

The Coal Trade.

The Northern coal trade on the whole shows a recovery from the recent weakness, and prices all round are fairly settled at about an average of late values. There has been a goodly amount of business placed, and this has absorbed many cancelled or postponed shipments. The colliery positions in many instances show a distinct improvement. Interference with navigation by ice in several Baltic and German ports has stopped prompt shipments, checking the stemming of tonnage against contract commitments in other instances. But this has been mostly counterbalanced by increased demands from other centres, especially for household coals and gas qualities owing to the cold weather throughout the United Kingdom and the Continent. The reports of threatened troubles in the British minefields are already causing activity amongst continental coal dealers. Dutch shippers are circularising many British centres and also Scandinavian importers offering coals to be shipped from Rotterdam to any extent. Operators in this area, however, do not anticipate that the negotiation will break down and result in a stoppage. Still, the negotiations with the miners and the threatened trouble with the locomotive men is causing shippers to endeavour to hurry forward their January requirements, and there is considerable pressure for prompt steam coals. A large number of boats have been stemmed during the past few days, and the coal fitters are now well supplied with tonnage for a fortnight ahead. The second-hand sellers are not pressing on the market, and there does not appear to be an excessive quantity of any class of coal for clearance this month, and in all branches quotations show a steady tone and improving tendency.

Shipbuilding Prospects Improving.

Shipbuilding prospects on the North-East Coast continue to improve, although shipowners are inclined to withhold contracts until the political situation is more stabilised. There will be considerably more work in the shipyards in the course of a few weeks. Several orders for machinery have been placed. Mr. R. S. Dalgliesh, the well-known shipowner of Newcastle-on-Tyne, has placed contracts for six vessels to be commenced immediately. Two will be built by Messrs. McMillan, Dumbarton, two by Messrs. Wood, Skinner and Co., on

the Tyne, and two by Messrs. Austin, Sunderland. The latter four will be of between 2000 and 3000 tons, and the Dumbarton ships of about 8500 tons each, and fitted with Harland Wolff Diesel engines. It is reported that owners have also placed an order with local builders for a vessel.

Cleveland Miners' Wages.

At a joint conference this week between the Cleveland Ironstone Mineowners and the miners' representatives an agreement was reached under which the Cleveland miners' wages will be reduced by 5 per cent. on and from the 28th inst. The men's wages will now be 84½ per cent. above the standard compared with 84 per cent. above a year ago.

SCOTLAND.

(From our own Correspondent.)

New Glasgow Harbour.

THE announcement that the Clyde Navigation Trustees have decided to proceed almost immediately to construct a new harbour is of great interest and importance to Glasgow and the West of Scotland. This scheme when completed will provide between Shieldhall and Renfrew a harbour with accommodation for the largest liners trading with, or built on, the Clyde, and will be capable of relieving the pressure on existing docks, thereby affording accommodation for smaller classes of cargo and passenger vessels convenient to the city. Many years must elapse before the entire scheme is completed, but long before that time the ultimate advantages will be made plain.

Fair Outlook.

Despite the clouds on the industrial horizon, the outlook is comparatively fair. Shipbuilding is recovering, and the improvement provides the main reason for the optimism expressed in industrial circles generally. New contracts for various descriptions of ships are still coming forward, and it is thought that this industry is over the worst and well on the way to permanent expansion. With regard to the miners' agreement, it is confidently expected that, if the terms of the agreement as to the three months' notice of termination are observed, a settlement of affairs will be reached within that period. What effect a railway strike may have is problematical. The managers have evidently made arrangements to carry on passenger traffic to some extent at least in the event of a strike being called, and probably arrangements will also be in hand to deal with goods also. In any case, motor transport would help to relieve the situation. It is, however, confidently hoped that the whole position will be quickly adjusted, and that the expansion in industry already apparent and so welcome may not be seriously impeded.

Steel and Iron.

The position at the steel works has not yet changed to any extent. Specifications for plates are not very numerous, and the demand for sections shows the greatest expansion. General inquiries are more promising, however. Engineers and bridge builders have good contracts booked, and railway orders must soon bear fruit. Steel sheets are still comparatively busy. Bar iron works are likewise in a better position than was the case a month or two ago. The greatest drawback at present is the level of quotations, which is not calculated to induce consumers to indulge in forward buying to any extent, especially in view of increased offerings of all descriptions of foreign materials at more advantageous prices. Pig iron and semi-finished materials are specially interested in this competition, and local consumers are looking for a drop in home prices. The present demand for pig iron is extremely moderate, both on home and export account.

Coal.

The coal market has been fairly quiet since the resumption for this year, especially in the export department. Foreign buyers are offering lower prices, but owners are disposed to preserve a firm attitude. Business over the next two weeks is comparatively good, but bookings beyond that period are very light, more particularly in respect of large coal. Washed nuts, and especially trebles, have a good market meantime. Better inquiries are reported, however, German buyers being more active, and France and Italy also being represented. Aggregate shipments during the past week amounted to 223,134 tons, against 120,037 in the preceding week, and 261,538 tons in the same week last year. A steady home demand is reported. Industrial sorts are more active, and house coal is quickly absorbed, while public utility concerns are, of course, taking large deliveries owing to the season of the year. Quotations are all firmly maintained so far.

Colliery Firemen.

At a meeting of the Scottish Colliery Under Manager's Association Executive Council, held in Glasgow last week, it was reported that the Minister of Mines had rejected a recommendation to alter Regulation 47, which permits a man holding a fireman's certificate to fill a position superior to fireman and inferior to under manager. Alteration of the regulations in this direction had also been proposed by Mr. Masterton, Divisional Inspector of Mines for Scotland.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE outlook in the coal industry is not particularly bright in view of the returns of the ballot on the question of terminating the present wages agreement, as the voting is overwhelmingly in favour of the prescribed three months' notice being given. In South Wales, although the official figures are not, at the moment, available, sufficient is known of the actual voting at the various collieries to show that the miners in this district have voted for the ending of the agreement to the extent of nearly eight to one. In these circumstances, and seeing that other districts have given a majority for the termination of the agreement, it is generally taken for granted that the leaders, after formally meeting to receive the results and laying the position before the owners, will take the step at the end of this month of tendering three months' notice, which means that the existing agreement will expire at the end of April, and that there is a danger of a strike as from May 1st. Hopes are, of course, entertained that long before that date steps will have been taken to avert such a disaster as an actual stoppage in the industry and, indeed, to see that the negotiations are not allowed to drag on to the last minute. An eleventh-hour settlement is dangerous to the interests of the industry, as it means that foreign consumers are compelled to make their arrangements for supplies elsewhere, thus driving trade away. It is just probable that the fears of trouble ahead are responsible for the better inquiry which has lately been received, especially from Italy, for coals for delivery during the next three months; but in other directions the market is very quiet, and so far as France is concerned it is highly improbable that the demand from the ordinary consumer will expand in view of the fact that the franc has depreciated to a marked extent, and is now in the neighbourhood of 90 to the pound sterling. This fall is bound to have an adverse influence upon business.

Third Shift Working.

At the moment of writing there is nothing definite to report regarding any arrangement for the operation of the partial third shift at Cardiff, Penarth and Barry, though, at the other ports in this district, the trimmers and tippers are carrying out the extra shift until the 19th inst., as requested by their leaders, so as to enable negotiations to proceed. The venue of the discussion between the parties was removed at the end of last week to London, where the position, as it affects the trimmers, came before the National Trimming Board. In the case of the tippers the financial side of the question was discussed between the men's leaders and representatives of the Great Western Railway Company; but the negotiations were abortive, and the whole matter was referred back for discussion at Cardiff where, on Tuesday, the Court of Inquiry appointed by the Ministry of Labour sat as a Conciliation Committee. Unfortunately, the outlook for a settlement does not appear to be very favourable, as the difficulties of agreement being reached are stated to be insurmountable. This, however, should not be the case. The Great Western Railway is stated to have made two offers to the tippers, both of which are reported to be inadequate and unacceptable to the men. In the first case, the company offered the men two split shifts with extra remuneration for overtime, consisting of a day and a night shift, the hours being from 8 a.m. to 5 p.m., and 9 p.m. to 6 a.m. respectively, with a meal hour in each shift. The time between the shifts would be used for marshalling the traffic and clearing the empty trucks from the tip roads and sidings, while the provision of overtime would mean that vessels which had nearly finished taking in their cargo at the end of a shift would be able to finish off and catch tides if necessary. Thus, despatch would be effected, and at times of congestion the scheme would probably be of considerable assistance to all concerned in the export trade. Furthermore, the earnings of the tippers would be improved, as fewer men would be needed to work two shifts only, and there would be fewer to share in the wages pool. The alternative offer was an addition of 33⅓ per cent. on the tariff for all coal shipped on the third shift, with the proviso that the cost of living sliding scale scheme, which was postponed during the operation of the partial third shift, should again come into operation. Both offers, however, have so far been turned down by the men.

1923 Trade Returns.

The Great Western Railway Company has issued this week particulars of the import and export trade for 1923 of the South Wales docks, which it owns, except that the figures do not include returns for Swansea, which docks were not taken over by the company until the middle of last year. The total trade, viz., import and export, amounted to 36,794,529 tons, which was 4,764,139 tons in excess of that for 1922, but 4,665,005 tons below the returns for the pre-war record year of 1913. Last year coal and coke shipments came to 31,679,362 tons, and other exports amounted to 1,070,519 tons, while imports came to 4,044,648 tons. In 1922 coal and coke shipments were 28,258,225 tons, and other exports 992,535 tons, while imports amounted to 2,779,630 tons. It will, therefore, be seen that coal and coke shipments and imports have considerably improved during the past twelve months as compared with 1922. The number of vessels which entered the various ports in South Wales during 1923 was 18,123 of a net registered tonnage of 16,041,377, compared with 17,715 vessels of 14,798,730 tons in 1922.

Siemens Steel Trade.

At the end of last week a joint conference of employers and workmen of the Welsh Siemens steel trade took place at Swansea to consider proposals which have been formulated for the setting up of a properly constituted joint authority to deal promptly with matters of dispute which may arise in the trade. Although the proceedings were private, it is reported that proposals for a written constitution on the basis of a Conciliation Board were submitted from the men's side, and that these proposals, with some amendments put forward by the employers, were adopted. It is understood that the scheme provides for a Conciliation Board on the lines of the Industrial Council in operation in the tin-plate industry which has been so successful.

Current Business.

The tone of the steam coal market has improved since I wrote a week ago, and the better qualities are very difficult to arrange for the current month's shipment as the collieries are very fully booked. One or two of the undertakings producing best Admiralty large qualities are now quoting 30s., and are not inclined to commit themselves to much business ahead on account of the uncertain outlook and the probability that the demand will later become much brisker. Superior small coals are also very scarce and firm. The market, although much better, is not free from weak spots, for the reason that the docks are somewhat congested. There have been over thirty steamers waiting to get into loading berths. Collieries may be fully sold and have tonnage waiting in dock, but as they cannot in all cases have their steamers in loading berths, some of them run short of empty wagons occasionally, and this fact weakens their position temporarily. The inquiry from Italy is more active, and shipments to foreign depôts are fairly brisk, while the inland demand is expanding, especially for anthracite coals. Consumers are disposed to lay in stocks in view of the prospect of labour troubles in the mines and on the railways.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Third Shift.

No settlement has been arrived at on the question of working the third shift at South Wales ports. The Court of Inquiry adjourned on Tuesday and has announced that it hopes to be able to issue a formal recommendation at an early date. If agreement is not reached shortly, the trimmers and tippers at Swansea, Newport, and Port Talbot will cease working the third shift at the end of this week, thus falling into line with the men at Cardiff, Penarth and Barry. Meanwhile there are about sixty vessels waiting for loading berths at South Wales ports.

Railways Contract.

It is reported that the Norwegian State Railways have purchased about 10,000 tons of Welsh steam large coals for shipment this and next month, the price being about 29s. net f.o.b.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

WE are asked to state that the Citroën Gear Company, Limited, has removed its offices from 28, Buckingham-gate, S.W. 1, to Citroën Building, Hammersmith, London, W.

W. WORBY BEAUMONT, M. Inst. C.E., of Outer Temple, 222, Strand, London, W.C. 2, asks us to state that his telephone number has been changed from Gerrard 4160 to City 7854.

BRUCE PEEBLES AND CO., Limited, engineers, Edinburgh, inform us that they have appointed Sellar Inglis and Co., of 144, St. Vincent-street, Glasgow, as their agents for the West and North of Scotland.

CALENDARS, DIARIES, &c.

LEPARD AND SMITHS, Limited.—Calendar with monthly tear-off sheets.

A. M. PEEBLES AND SON, Limited.—Memorandum pad with weekly sheets.

PECKETT AND SONS, Limited, Bristol.—Wall calendar with monthly tear-off sheets.

G. CRADOCK AND CO., Limited, Wakefield.—Wall calendar with monthly tear-off sheets.

CROMPTON AND CO., Limited, Chelmsford.—Wall calendar with monthly tear-off sheets.

FLOWERDEW AND CO., 227/8, Strand, W.C. 2.—Desk calendar with monthly tear-off sheets.

THOMAS ROBINSON AND SON, Limited, Rochdale.—Refill for desk calendar. Daily tear-off sheets.

C. A. PARSONS AND CO., Limited, Newcastle-on-Tyne.—Wall calendar with monthly tear-off sheets.

LANCASHIRE UNITED TRAMWAYS, Limited, Atherton, Lancs.—Wall calendar with monthly tear-off sheets.

METCHIM AND SON, 8, Princes-street, Westminster, S.W. 1.—A copy of the Surveyors' Tables and Diary.

JOHN HOLROYD AND CO., Limited, Milnrow, near Rochdale.—Wall calendar with monthly tear-off sheets.

R. Y. PICKERING AND CO., Limited, Wishaw, Scotland.—Wall calendar with monthly tear-off sheets.

REASON MANUFACTURING COMPANY, Limited, Brighton.—Art metal desk calendar with monthly cards.

FULLER'S UNITED ELECTRIC WORKS, Limited, Chadwell Heath, Essex.—Refill cards for desk calendar.

AITON AND CO., Limited, Derby.—A large collotype picture of Lancing, Sussex. Small monthly tear-off sheets.

HOLLINGS AND GUEST, Limited, Thimble Mill-lane, Birmingham.—Wall calendar with monthly tear-off sheets.

PRIEST FURNACES, Limited, 123, Albert-road, Middlesbrough.—Refill for desk calendar with daily tear-off sheets.

NEWTON, CHAMBERS AND CO., Limited, Thorncliffe Ironworks, near Sheffield.—Wall calendar with daily tear-off sheets.

BRITISH CHEMICAL PLANT MANUFACTURERS' ASSOCIATION, 166, Piccadilly, W. 1.—Wall calendar with weekly tear-off sheets.

R. AND W. HAWTHORN, LESLIE AND CO., Limited, Newcastle-on-Tyne.—Wall calendar with daily and monthly tear-off sheets.

W. JOHNSON, GILL SEALE AND CO., Limited, 5/6, Great Winchester-street, E.C. 2.—Wall calendar. Monthly tear-off sheets.

WELIN DAVIT AND ENGINEERING COMPANY, Limited, Hopetoun House, Lloyd's-avenue, E.C. 3.—Set of refill cards for desk calendar.

BRAITHWAITE AND CO. (ENGINEERS), Limited, 117, Victoria-street, S.W. 1.—Pocket diary with many pages of information useful to engineers.

INGERSOLL-RAND COMPANY, Limited, 165, Queen Victoria-street, E.C. 4.—A copy of the Ingersoll-Rand Engineer's Handbook and Diary for 1924.

BELDAM PACKING AND RUBBER COMPANY, Limited, 29, Gracechurch-street, E.C. 2.—Wall calendar, "Port of Calcutta," a picture in colours. Monthly tear-off sheets.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	19/6 to 20/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 8 9	—
No. 1 Foundry	5 10 0	—
No. 3 Foundry	5 5 0	—
N.E. COAST—		
Hematite Mixed Nos.	5 2 6	5 2 6
No. 1	5 3 6	5 3 6
Cleveland—		
No. 1	5 2 0	5 2 0
Silicious Iron	5 2 0	5 2 0
No. 3 G.M.B.	4 19 0 to 5 0 0	4 19 0 to 5 0 0
No. 4 Foundry	4 16 6	4 16 6
No. 4 Forge	4 15 6	4 15 6
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 10 0 to 4 12 0	
„ „ Foundry	4 17 6 to 5 0 0	
(3) Northampton—		
Foundry No. 3	4 13 6 to 4 15 0	
„ Forge	4 7 6 to 4 8 6	
(3) Derbyshire—		
No. 3 Foundry	4 15 0 to 4 17 6	
Forge	4 8 0 to 4 10 0	
(3) Lincolnshire—		
No. 3 Foundry	4 15 0	—
No. 4 Forge	4 14 0	—
Basic	4 15 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 15 0 (a) / 6 0 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E. COAST—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
LANCS.—		
Crown Bars	12 10 0	—
Second Quality Bars	11 15 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best „	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	12 10 0	—
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 2 6 to 11 5 0	
Gas Tube Strip	12 15 0 to 12 17 6	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ½in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 5/16in. to ½in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 0 0	—
Joists	10 0 0	—
Heavy Rails	9 10 0	—
Fish-plates	13 0 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
Hoops	14 10 0	—
MANCHESTER—		
Bars (Round)	10 10 0 to 10 15 0	
„ (others)	10 5 0 to 10 7 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 10 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 10 0	—
MIDLANDS—		
Small Rolled Bars	10 15 0 to 11 0 0	
Billets and Sheet-bars	8 10 0	—
Gas Tube Strip	10 15 0 to 11 6 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 10 0	—
Angles	10 0 0	—
Joists	10 0 0	—
Tees	11 0 0	—
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	23/9 to 24/3
Block Tin (cash)	251 0 0
„ (three months)	252 5 0
Copper (cash)	60 12 6
„ (three months)	61 5 0
Spanish Lead (cash)	31 5 0
„ (three months)	30 17 6
Spelter (cash)	34 7 6
„ (three months)	33 17 6
MANCHESTER—	
Copper, Best Selected Ingots	66 10 0
„ Electrolytic	68 0 0
„ Strong Sheets	93 0 0
„ Tubes (Basis price)	0 1 1
Brass Tubes (Basis price)	0 1 0
„ Condenser	0 1 2½
Lead, English	32 15 0
„ Foreign	31 5 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£22 10 0	8/-
„ 8 p.c. to 10 p.c. „	£21 10 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£45 0 0	18/-
„ „ 1 p.c. „	£54 0 0	21/-
„ „ 0.75 p.c. carbon	£65 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 5 0 scale 5/- per unit	
„ „ 75 p.c.	£18 10 0 scale 6/- per unit	
„ Vanadium	20/- per lb.	
„ Molybdenum	6/6 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£130	
Cobalt	11/- per lb.	
Aluminium (per ton)	£82 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	24/6
„ „ Ell	25/6
„ „ Splint	26/- to 27/6
„ „ Trebles	25/6
„ „ Doubles	24/-
„ „ Singles	21/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	24/6
„ „ Splint	26/-
„ „ Trebles	25/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	21/3 to 24/-
Screened Navigation	28/-
Trebles	26/6
Doubles	24/-
Singles	22/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	24/-
Secondary Steam	22/6
Trebles	26/-
Doubles	24/3
Singles	22/-

ENGLAND.

(8) N.W. COAST—	
Steams	29/-
Household	48/- to 50/-
Coke	43/6
NORTHUMBERLAND—	
Best Steams	24/3 to 25/6
Second Steams	22/6 to 23/-
Steam Smalls	15/-
Unscreened	21/- to 22/-
Household	25/- to 28/-
DURHAM—	
Best Gas	24/6 to 25/-
Second	23/- to 23/6
Household	26/- to 28/-
Foundry Coke	50/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	35/- to 36/-	—
Barnsley Best Silkstone	30/6 to 32/-	—
Derbyshire Best Brights	30/- to 32/-	—
„ „ House	26/- to 27/-	—
„ „ Large Nuts	24/6 to 25/6	—
„ „ Small „	18/6 to 20/6	—
Yorkshire Hards	22/6 to 23/6	—
Derbyshire „	21/- to 22/6	—
Rough Slacks	12/6 to 13/6	—
Nutty „	10/- to 12/-	—
Smalls	5/- to 8/-	—
Blast-furnace Coke (Inland)	27/- to 29/-	
„ „ (Export)	f.o.b. 31/6 to 35/6	

CARDIFF— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	29/- to 30/-
Second „ „	28/- to 28/6
Best Dry Large	27/- to 28/-
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	27/6 to 28/-
Western Valley „	27/- to 27/6
Best Eastern Valley Large	27/- to 27/6
Ordinary „ „	26/- to 27/-
Best Steam Smalls	21/- to 22/-
Ordinary „	19/- to 21/-
Washed Nuts	28/- to 30/-
No. 3 Rhondda Large	28/- to 29/-
„ „ Smalls	25/- to 26/-
No. 2 „ Large	24/- to 25/-
„ „ Through	20/- to 22/-
„ „ Smalls	19/- to 20/-
Coke (export)	52/6 to 55/-
Patent Fuel	30/- to 32/6
Pitwood (ex ship)	28/6 to 29/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	40/- to 42/6
Seconds	32/6 to 35/-
Red Vein	29/- to 30/-
Machine-made Cobbles	52/6 to 55/-
Nuts	52/6 to 55/-
Beans	42/6 to 45/-
Pens	26/- to 27/-
Breaker Duff	13/9 to 13/-
Rubbly Culm	13/6 to 14/-
Steam Coals:	
Large	24/6 to 25/-
Seconds	22/- to 23/-
Smalls	14/- to 16/-
Cargo Through	19/- to 21/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

† Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Deepening the Seine.

THE alarm having subsided with the floods, attention is now being centred in the various projects that have been brought forward to prevent their repetition in the future. The proposals that appeal particularly to the people's representatives on the Paris Municipal Council and in Parliament, who are endeavouring to secure funds to carry them out, provide for the diversion of surplus water by means of a canal from the Marne to the Seine to the north of the city, and also for the storage of such water in vast reservoirs, principally near the sources, where it would be available for distribution to Paris and for keeping up the level of the Seine in times of drought. The schemes do not meet with support from the municipal and State engineers, who argue that the Marne canal would not serve any other useful purpose, and the discussion in the Chamber of Deputies has revealed that the Government is committed to the proposal to deepen the Seine between the Port de l'Anglais and Rouen to permit of fairly large cargo boats reaching Paris, which is to be equipped with a series of extensive docks. It is, nevertheless, argued by some that the deepening of the Seine below Paris will not prevent the banking up of the water during its narrow passage through the city, but the Minister of Public Works affirms that this danger will be avoided by the widening of the arm of the Seine at the Monnaie and by the reconstruction of the Alma bridge, which are the principal impediments to the flow of the river. Nevertheless, it does not appear as if the navigation works, which are expected to serve as a means of regulating the Seine, will be carried out with any celerity. This undertaking, as well as many others, was sanctioned without there being even a reasonable hope of providing the necessary funds, and in the present state of things it is extremely doubtful whether a loan for the purpose would meet with any success. So cautious, indeed, is the Government in making any appeal for funds to carry out public works, that Parliament has reduced considerably the amount of the loan which it has authorised the Department of the Seine to issue for the execution of works in Paris and for the Seine navigation scheme. The total amount has been limited to 180 million francs, and instead of allowing 175 millions towards the cost of the navigation works, the Chamber of Deputies has cut the sum down to 74 millions for widening the arm of the Seine at the Monnaie and for deepening the river between Suresnes and Bougival.

Trade Activity.

While the further heavy fall in the value of the franc is causing considerable uneasiness, in view of the effects it may have upon production costs, when so much fuel and other material has to be purchased from abroad, it has not militated against the situation of many of the leading engineering concerns, which are receiving a fair number of orders, particularly for railway rolling stock. Locomotive and wagon builders have been so long employed in repairing old stock that the distribution of orders is reviving confidence in this branch of industry. An increasing business is also being done in small locomotives with internal combustion engines for collieries and other purposes. In other branches there is generally sufficient employment, but few new orders are being given out in view of the uncertain future, and confidence has been seriously weakened by the currency depreciation. It is true that the low value of the franc is favouring metallurgical exports for the time being, and in view of the country's huge productive capacity, this phase of the situation should not be lost sight of by British iron and steel firms; but, on the other hand, the exchange rate has considerably diminished the purchasing power of railway companies, municipalities and others, which, soon after the war, secured loans in sterling and dollars.

Rural Electrification.

The future of the electrical engineering industry appears to be particularly bright, in view of the progress being made with the scheme of national electrification. Such undertakings as the canalisation of the Rhone and the laying down of vast hydro-electric plants along its course, are being held up for want of funds, but a great deal is being done with the utilisation of hydraulic power in the Alps and the Pyrenees, and in the northern departments high-tension mains are being laid down over such a wide area that in a very short time the north will be almost entirely electrified. So far, less headway has been made with the system of rural electrification, which is being especially encouraged by the Government in the belief that an improvement in the conditions of rural existence will prevent a migration to the industrial centres and will, at the same time, enable farmers to realise economies in motive power. A law has recently been promulgated authorising loans to co-operative societies and others under conditions that are intended to allow of their repayment, as far as possible, out of profits, and it is stipulated that where these loans are granted the electrical plant employed must be preferably of French manufacture, while in the event of its being impossible to procure such machinery in the country, permission must be obtained from the Minister of Agriculture to purchase it abroad.

Electrical Schemes.

The programme of electrical development during the next fifteen years provides for the installation of plant with a total capacity of 4,5000,000 kilowatts, of which 1,200,000 kilowatts will be supplied by the Rhone and the Rhine. It is doubtful whether the programme will be carried out in the allotted time, but it is expected that during the course of the present year, the total capacity of the electrical plants, both thermic and hydraulic, will be nearly 2,500,000 kilowatts. Already close upon 10,000 communes are electrified.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

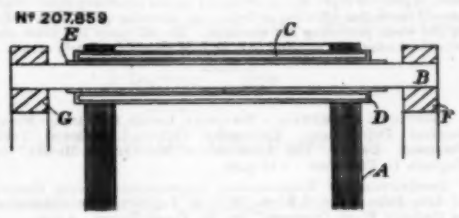
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

207,859. September 5th, 1922.—ELECTRICAL CONDUCTORS FOR ALTERNATING CURRENT, Thomas Frederick Wall, Carr Bank House, Fulwood, Sheffield.

The invention relates primarily to electric induction motors of the squirrel cage type, and has for its object the improvement of the starting characteristics of such motors. The rotor core of laminated iron is shown at A, and near the outer periphery of this core a number of equally spaced holes or slots are provided in the usual way. The central core of one of the composite conductors arranged in its slot and constructed in accordance with this invention is shown at B. A sheath of magnetic material is shown at C, and favourable results are obtained if this sheath is formed from solid drawn steel tube. By the use of such material, a small magnetic reluctance of the tube is obtained in the direction of the lines of force due to a current in the central core. Any longitudinal seam in the tube would tend to increase the reluctance in the required direction, and so diminish the effectiveness of the magnetic path for the purpose in view. Completely surrounding this steel tube is a covering of good conducting material D, *e.g.*, copper foil, which forms a good electrical circuit for currents induced in the direction parallel to the axis of the conductor B. The steel tube C, with its covering D, are insulated from the central core B by the

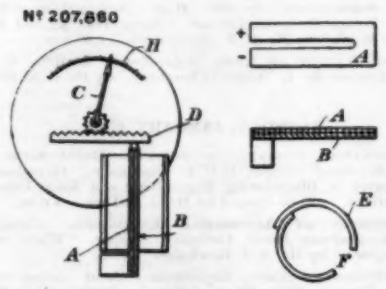


insulation E. The central cores B of all the conductors are connected at each end of the respective end rings F and G. The stator used in conjunction with this rotor core may be of any of the types usual for induction motors. The action of the arrangement is as follows:—Each composite conductor is, in effect, a short-circuited transformer of which the primary winding is the central core B, the magnetic core of the transformer is the steel tube C, and the short-circuited secondary winding is the covering D. When the stator winding is switched in circuit, the consequent rotating field in the air gap of the motor induces electromotive forces in the central cores, such as B, of which the frequency is the same as the frequency of the supply mains to which the stator is connected. Induced currents will consequently flow in the central cores B, the circuits being completed through the end rings F and G. The alternating currents in the cores B set up alternating fluxes in the respective steel tubes C, and corresponding alternating currents will be induced in the conducting coverings D. The effective resistance of the central cores B will be relatively high at starting, since the frequency of the induced currents has then a high value, viz., that of the supply mains. As the rotor runs up to speed, the frequency of the induced currents diminishes correspondingly, and the effective resistance of the central cores B also diminishes. —*December 5th*, 1923.

ELECTRICAL APPLIANCES.

207,860. September 5th, 1922.—A DEVICE FOR INDICATING OR CONTROLLING THE TEMPERATURE OF THE WINDINGS OR OTHER PARTS OF ELECTRIC MACHINES THROUGH WHICH THE CURRENT FLOWS, Edmund Schröder, of Maybach-Ufer 48–51, Berlin, S.O. 36, Germany.

This invention relates to devices for indicating or controlling the temperature of the winding or other parts of electric machines through which current flows, having essentially the same heating characteristic as the part to be protected. The machine current flows through a conductor consisting of a tongue of two metals A B, having different coefficients of expansion. The conductor or tongue constitutes a movable element adapted to operate the pointer C of an indicator through the medium of a rack D and a pinion. When the conductor is heated under the action of the current, it bends—because of the different coefficients of

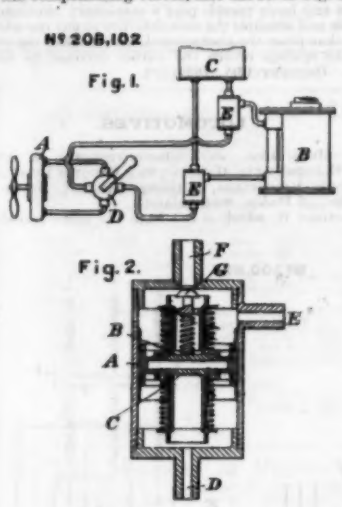


expansion of the two metals of which it is composed—thereby actuating the gear for moving the pointer C. The conductor A B is surrounded by an envelope E, consisting of two cylindrical parts of non-conducting material, slidable one over the other. By turning the parts of the cylinder relatively to one another, the opening F can be widened or narrowed or closed entirely, and the insulating effect of the envelope can be altered, whereby the conductor can be made to vary in temperature synchronously with the temperature of the parts of the machine that have to be protected from overheating. If the scale H be properly marked, the pointer C will at all times indicate the temperature of the windings. If the apparatus is fitted, for example, to a motor, then any overload on the motor can easily be ascertained because the limit up to which overload is permissible can be seen from the pointer.—*December 5th*, 1923.

AERONAUTICS.

208,102. September 6th, 1922.—HYDRAULIC CONTROL GEAR, The English Electric Company, Limited, and W. O. Manning, Queen's House, 28, Kingsway, London, W.C. 2.

This device is intended for use in conjunction with double-acting hydraulic cylinders, for operating tail planes, &c. The displacement volume of one end of the cylinder is smaller than that of the other, on account of the piston-rod, and this device compensates for the difference. Referring to Fig. 1, A is the pump, B the cylinder, C the reservoir, and D a three-way valve for reversing the delivery of the pump to the cylinder. E E are the compensating valves, also shown in Fig. 2. Refer-

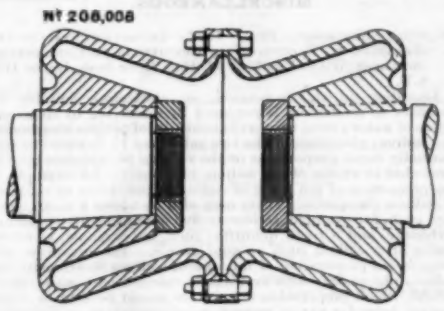


ring to Fig. 2, A is a floating piston, in which there are seated two inwardly opening valves B and C. Supposing that the branch D is connected with the suction side of the pump, the piston will be pulled down till the stem of the valve C touches the bottom cover. Further movement of the piston will open the valve C and then the other valve B will be opened by the suction and communication will be established with the branch E, from which the oil will be sucked and any surplus will go by the branch F to the reservoir. A somewhat similar action takes place on the pressure stroke when the piston is driven upward and the valve G closes the outlet to the reservoir.—*December 6th*, 1923.

TRANSMISSION OF POWER.

208,008. December 5th, 1922.—FLEXIBLE COUPLINGS, K. Baumann, Northwood House, Barnfield, Urmston, Lancashire, and the Metropolitan-Vickers Electrical Company, Limited, 4, Central-buildings, Westminster.

In accordance with this invention each part of the coupling comprises a sleeve united by a web or diaphragm with a torque-

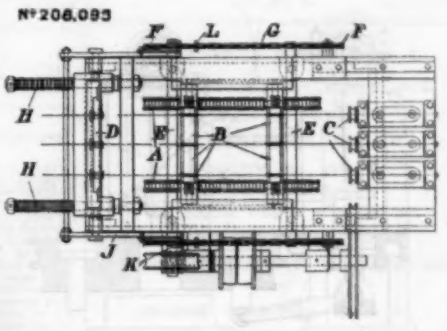


transmitting member surrounding the sleeve and having a flange at the end remote from the web or diaphragm. The web or diaphragm is of such a shape as to give the maximum amount of flexibility to the coupling as a whole with regard to angular and excentric displacement of the shafts to be coupled. The drawing is self-explanatory.—*December 13th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

208,093. June 23rd, 1923.—WIRE CUTTING-OFF MACHINES, J. Thompson, Atlas Ironworks, Brighouse, Yorkshire.

Referring to the plan, A indicates endless chains carrying wire holders B which draw the wires through straightening spinners C and pass them through cutting dies in a carriage D. Fixed on the shafts E which carry sprocket wheels for the endless chains A are two similar sprocket wheels F which support



and drive the measuring chains G. The latter are formed with detachable links so that they may be shortened or lengthened to suit any particular requirement. The lower portions of the chains pass under guide pulleys adjustably mounted in slots in the framework. The cutter carriage D carries a set of movable dies and a set of stationary dies, and is slidably mounted on two rods H attached to a stationary cross bar, which

also constitutes a guide for the wires. The cutter carriage is normally maintained in the position shown by springs on the rods H. Pivotally mounted on the cutter carriage are two arms J which are connected together at one end by a rod. Attached to the other ends of the arms are two abutments K which rest on the tops of the measuring chains G. The latter are fitted at intervals with abutments L which are spaced apart according to the length of the pieces of wire to be cut off. In the example shown these abutments are made in the form of elongated pivot pins for certain of the chain links. When a pair of abutments on the two chains comes in contact with the levers they push the cutter carriage forward against the action of the springs. During this movement of the carriage a trip lever travels past a stationary abutment on the framework and actuates the movable dies to cut the wire. After this has taken place the abutments L travel below the abutments K and the springs return the cutter carriage to its normal position.—*December 13th*, 1923.

LOCOMOTIVES.

200 803. June 15th, 1923.—IMPROVEMENTS IN APPARATUS FOR ELECTRICALLY HEATING THE VACUUM PUMP IN METAL VAPOUR RECTIFIERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

The rectifier B, which is fed from the main transformer A,

delivers direct current into the network C. The exciting current circuit is fed from an auxiliary network D through the exciting transformer E, and the voltage for the heating body F of the mercury vapour air pump is taken from the secondary side of the exciting transformer.—*December 13th*, 1923.

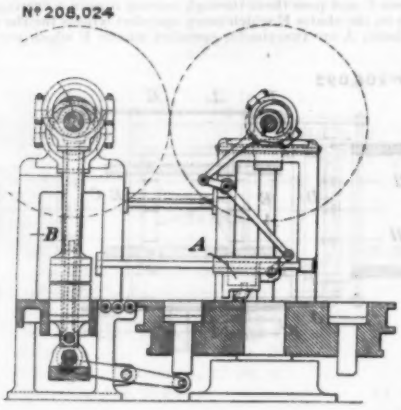
MISCELLANEOUS.

207,987. November 20th, 1922.—IMPROVEMENTS IN OR RELATING TO ELECTROLYTIC RECTIFIERS OR CONDENSERS, Mortimer Arthur Codd, of 32, Half Moon-lane, Herne Hill, S.E.

According to this invention, an electrolyte suitable for rectifiers or condensers is prepared by dissolving in about one gallon of water a total weight of about 1 lb. of sodium bicarbonate and sodium phosphate. The two salts may be in equal or substantially equal proportions or the sodium bicarbonate may be somewhat in excess of the sodium phosphate; for example, in the proportion of ten parts of sodium bicarbonate to six parts of sodium phosphate. There may also be added a small quantity, such, for example, as four or five pennyweights of calcium carbonate, and a small quantity, such, for example, as fifteen grains of a colloid such as gum arabic. The invention also comprises a preparation of mixture of sodium bicarbonate and sodium phosphate, with or without calcium carbonate, and a colloid, which preparation or mixture would be sold in a convenient form for use in preparing an electrolyte as described. An electrolyte prepared as above described and used in an electrolytic rectifier or condenser presents advantages over electrolytes hitherto known. It does not bent to the same extent as hitherto known solutions, efficient rectification takes place at higher temperatures than with hitherto known solutions, and the plates of the rectifier or condenser keep cleaner.—*December 16th*, 1923.

208,024. January 3rd, 1923.—BRICKMAKING PRESSES, T. Stanley, 177, Sneyd-street, Cobridge, Stoke-on-Trent, and T. S. Whitfield, Sylvan House, Basford, Stoke-on-Trent.

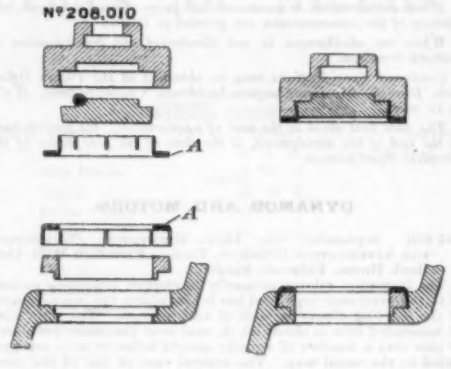
This invention is concerned with the lubrication of the mould table and blocks on rotary brickmaking machines. A is the



pusher plate, which is used to transfer the moulded bricks from the rotary table to the finishing press B. The plate is cast hollow and in its bottom there is a series of wick-feed lubricating pipes. The wicks dip in oil in the hollow casting and wipe across the table as the pusher is operated.—*December 13th*, 1923.

208,010. December 16th, 1922.—VALVE SEATINGS, W. N. Baines and Co., Limited, and J. G. Reid, Phœnix Brass Works, Rotherham.

The inventors propose to provide both the valve and its



seating with separate wearing pieces A A. These pieces are forced into conical grooves, as shown by the right-hand views, by means of a hydraulic press.—*December 13th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department, University College, Singleton Park, Swansea. Paper, "The Annealing of Non-ferrous Metals," by Captain L. Taverner. 7.15 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Lecture, "Reminiscences of Railway Work Overseas," by Mr. Frank Grove. 8 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON).—College of Technology, Sackville-street, Manchester. Ordinary general meeting. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecturette, "The Liability of Employers in Respect of Personal Injuries to their Workmen," by Mr. G. F. Tyler. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne. Paper, "The Influence of Type of Propelling Machinery on the Running Costs of Ships," by Mr. W. G. A. Perring.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "The Scientific Work of Professor Sir James Dewar," by Professor H. E. Armstrong. 9 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, S.W. 1. Informal meeting. Discussion, "British Locomotive Practice and Performance," introduced by Mr. R. E. L. Maunsell. 7 p.m.

SATURDAY, JANUARY 19TH.

JUNIOR INSTITUTION OF ENGINEERS.—Visit to the County Hall, Westminster Bridge. 2.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Visit to the office of the *Newcastle Chronicle*. 2.30 p.m.

MONDAY, JANUARY 21ST.

BRADFORD ENGINEERING SOCIETY.—Technical College, Bradford. "Suction Plant for Cleaning Boiler Flues," by Mr. H. C. Booth. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: SCOTTISH CENTRE.—Royal Technical College, Glasgow. Paper, "Electric Starting and Lighting Equipment for Automobiles and Motor Cycles," by Captain A. C. Burgoine. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's Gate, Westminster, S.W. 1. "Recent Improvements in Locomotive Efficiency," by Mr. E. L. Diamond. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS: NEWCASTLE-UPON-TYNE ASSOCIATION.—Neville Hall, Newcastle-upon-Tyne. Second Vernon-Harcourt Lecture, "River Training and Maintenance Work," by Mr. R. F. Hindmarsh. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Cantor Lecture No. 1, "Colloid Chemistry," by Dr. E. K. Rideal. 8 p.m.

TUESDAY, JANUARY 22ND.

ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Discussion, "Co-ordination of Research in Illuminating Engineering and Some Practical Applications," will be opened by Mr. J. S. Dow. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Railway Hotel, Coventry. Paper, "Water-cooled Aero-engines," by Mr. A. J. Rowledge. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Papers: "The Effect of Shape of Catchment on Flood Discharge," by Colonel G. R. Hearn; "Discharge from Catchment Areas in India, as affecting the Waterways of Bridges," by Mr. G. E. Lillie; "Floods of the Damodar River, and Rainstorms Producing Them," by Mr. E. L. Glass. 6 p.m.

WEDNESDAY, JANUARY 23RD.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Milton Hall, 244, Deansgate, Manchester. Paper, "Electric Starting and Lighting Equipment for Automobiles and Motor Cycles," by Captain A. C. Burgoine. 6 p.m.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover-square, W. 1. Papers, "Some Failures in Steel as Revealed by the Microscope and Recorded by Photography," by Captain J. W. Bamfylde; "The Use of the Microscope in the Petroleum Industry," by Mr. H. B. Milner. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, S.W. 1. Students' meeting. Lecture, "The Work of a Mechanical Engineer's Office," by Mr. A. J. Hill. 6 p.m.

THURSDAY, JANUARY 24TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Informal meeting. Testing instruments will be demonstrated and discussed. 6.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "Dopes and Fabrics," by Dr. J. E. Ramsbottom. 5.30 p.m.

FRIDAY, JANUARY 25TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Holborn Restaurant, W.C. 1. South-Eastern District dinner. 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Lecture, "Molecular Attraction and its Relation to Engineering," by Professor Edwin Edser. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle street, Piccadilly, W. 1. Discourse, "The Future Development of London," by Sir Aston Webb. 9 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate Westminster, S.W. 1. Lecture, "The Progress of Mechanical Engineering in the Military Service," by Major G. Le Q. Martel. 6 p.m.

SATURDAY, JANUARY 26TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London graduates visit to the works of the Power Plant Company, Limited, West Drayton. Train from Paddington, 1.50 p.m.

MONDAY, JANUARY 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Graduates' meeting. Paper, "Brakes," by Mr. C. H. Barker. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS: NORTH-WESTERN SECTION.—Textile Institute, 16, St. Mary's Parsonage, Manchester. Paper, "Some Developments in Electricity Supply," by Mr. S. L. Pearce. 7.30 p.m.

TUESDAY, JANUARY 29TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower-hill, E. 1. "The Gas Turbine," by Mr. Hugh Campbell. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Some Particulars of the Manufacture of Pneumatic Tires," by Mr. W. Knight. 7.15 p.m.

WEDNESDAY, JANUARY 30TH.

INSTITUTION OF CIVIL ENGINEERS.—Students' visit to the Chiswick Research Laboratory of the Still Engine Company, Limited.

FRIDAY, FEBRUARY 1ST.

UNIVERSITY COLLEGE, LONDON, ENGINEERING SOCIETY.—The College Refectory, Gower-street, W.C. 1. Annual Dinner and Conversazione.

MONDAY, FEBRUARY 4TH.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, W. 1. Presidential address by Mr. G. A. Becks. 5.30 p.m.

WEDNESDAY, FEBRUARY 6TH.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, E.C. 4. Various short papers will be read and discussed. 5.30 p.m.

CONTRACTS.

WE are informed that all the water meters to be employed throughout the grounds and on exhibitors' stands at the forthcoming British Empire Exhibition are to be supplied by Geo. Kent, Limited, of London and Luton.

VICKERS Limited, hydro-electric department, has received an order for a 25,000 horse-power water turbine, which will be installed at Calumet Island, on the Ottawa River, in Canada. The river falls 60ft. at this point, and a power station is now under construction, which will eventually house three units such as this which is in all respects the largest single-runner Francis water turbine ever built in England.

VICKERS, Limited, of Barrow-in-Furness, have recently received an order for Japanese owners for two marine heavy oil engines of 600 brake horse-power, to be duplicates of the engine recently delivered to the order of their associates, Mitsubishi Shoji Kaisha, Limited. These engines are of the four-stroke cycle crosshead type with six cylinders, 18¼in. diameter by 27in. stroke, and easily develop the required power at 150 revolutions per minute.

THE POWER-GAS CORPORATION, Limited, of Stockton-on-Tees, informs us that it has received an order for one of its new system low-temperature by-product recovery gas producer plants from William Tod, jun., and Co. (1923), Limited, of Springfield Paper Mills, Polton, Midlothian. The plant is to be capable of dealing with some 50 tons of fuel per twenty-four hours, and the gas it produces will be used for boiler firing. The installation will include coal-handling plant, sulphate of ammonia recovery and evaporating plant and tar dehydrating plant. The same firm has also received an order from the Coal Industrial Company of Poland for the supply of drawings to enable a similar plant of approximately the same capacity to be constructed abroad.

INVENTION.—Mr. Bertram Joy, of 168, Regent-street, has written a wise little essay on invention, and has published it at the price of 1s. under the name "Practical Invention." It does not go deeply into the art of inventing, but it gives the inexperienced inventor a great deal of sound, common-sense advice—the kind of advice, that is to say, that a large majority of inventors need.

UNIVERSITY COLLEGE ENGINEERING SOCIETY.—At the annual dinner of the University College (London) Engineering Society, which will be held in the College Refectory on Friday, February 1st, the chair will be taken by Professor E. G. Coker, F.R.S. Old students of the Faculty of Engineering who have not yet received notice of the dinner are requested to communicate at once with the honorary secretary of the Engineering Society at the College. The dinner will be followed by a conversazione, when the new laboratories will be open for inspection.